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ABSTRACT

This booklet, one of a series developed by the Frederick County Board of Education, Frederick, Maryland, provides an instruction module for an individualized or flexible approach to 7th, 8th, and 9th grade science teaching. Subjects and activities in this series of booklets are designed to supplement a basic curriculum or to form a total curriculum, and relate to practical process oriented science instruction rather than theory or module building. Included in each booklet is a student section with an introduction, performance objectives, and science activities which can be performed individually or as a class, and a teacher section containing notes on the science activities, resource lists, and references. This booklet presents independent study of astronomy, astronomical instruments, the solar system, Earth time zones, and stars. The estimated time for completing the activities in this module is 8-9 weeks. (SL)

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# AIDS TO INDIVIDUALIZE THE TEACHING OF SCIENCE

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# MINI-COURSE UNITS

BOARD OF EDUCATION OF FREDERICK COUNTY

1973

SE 021 653

Frederick County Board of Education

# Mini Courses for

# Life, Earth, and Physical Sciences

## Grades 7, 8, and 9

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1973

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## FOREWORD

The contents represented in these modules of instruction, called mini courses, is an indication of our sincere desire to provide a more individualized and flexible approach to the teaching of science.

Data was accumulated during the school year relative to topics in life, earth, and physical science that were felt to be of greatest benefit to students. The final selection of topics for the development of these courses during the workshop was made from this information.

It is my hope that these short courses will be a vital aid in providing a more interesting and relevant science program for all middle and junior high school students.

Dr. Alfred Thackston, Jr.
Assistant Superintendent for Instruction


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# AN ATTEMPT TOWARDS INDEPENDENT STUDY IN ASTRONOMY

Prepared by

John E. Geist

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General Information

Detailed Information

Estimated Teaching Time

8-9 weeks

AN ATTEMPT TOWARDS INDEPENDENT STUDY IN ASTRONOMY

## ASTRONOMICAL INSTRUMENTS

INTRODUCTION:

Astronomers use special instruments to learn about space, distant stars and planets. Two instruments are very important and are rather easy to use. You will construct one of them later. Can you name these instruments?

OBJECTIVES:

Students will be able to complete the following.

1. Distinguish between refractor and reflector telescope.
2. Identify several large telescopes by name and size.
3. Describe the spectrum and its cause and list several uses of it in astronomy.
4. List pioneers in astronomy.
5. Differentiate between planetarium and observatory.
6. Define: spectroscope
   Dopples Effect
7. Identify the 3 types of spectra.

ACTIVITIES:

Telescopes:

1. Students will draw and label how light travels within a refractor and reflector telescope. (Turn this in.)
2. Students will focus the refractor and/or reflector telescopes. Compare (discuss) them as to ease of focus, stability, identification of parts.
3. Answer questions on Worksheet #1 below each question. Use your texts. Turn this in.

Spectroscopes:

4. Students will construct a shoebox spectroscope. Obtain instructions and materials from your teacher.
5. Using your spectroscope, answer the problems on the spectrum lab page. (Obtain other materials from your teacher.)

6. Answer questions on Worksheet #2 below each question. Use your texts. (Turn this in.)

7. Research: Choose a topic from those below and write several paragraphs on it. Include your source and use good grammar. You may do more than one topic. Each counts EXTRA CREDIT. (Turn this in.)

a. Copernicus
b. Newton
c. Kepler
d. Doppler
e. Diffraction grating
f. Rainbows
g. Wave length theory of light
h. Fravenhoffer lines
i. Stonehenge

EVALUATION:

In addition to completing the activities, this will consist of a short quiz. Study your worksheets and drawings. Refer to the objectives to check yourself.

WORKSHEET #1

Astronomical Instruments

(Answer below each question; when you have finished, turn this in.)

1. Explain how a refractor telescope works.

2. Explain how a reflector telescope works.

3. List 3 ways telescopes differ.

4. Why is a telescope better than our eyes?

5. Define or explain:

   a. objective lens

   b. eyepiece

   c. light gathering power

   d. Galileo

   e. astronomy

6. Distinguish between planetarium and observatory.

7. What was Stonehenge?

8. Identify the name and size of the largest refractor.

9. Identify the name and size of the largest reflector.

10. What 3 other kinds of telescopes are there and what does each do?

WORKSHEET #2

Astronomical Instruments

(Write answers below each question and turn this in.)

1. Distinguish between spectrums, spectra and spectroscope.

2. List 3 uses of the spectroscope.

3. Explain the cause of the spectrum.

4. Identify the 3 kinds of spectra and a possible cause of each.

5. Distinguish between "red" and "blue" shift.

6. Explain and pose an example of the Doppler Effect.

7. List all 7 colors of the spectrum and write a method for remembering them.

8. Identify a spectrum made by nature.

9. Why is the bright-line spectrum so important in astronomy?

## SPECTRUM LAB PAGE

(Complete this page and turn in.)

1. Observe the spectrum on the inside of your spectroscope. List below the colors you see and make a color drawing of it.

2. Observe the continuous spectra in the classroom and complete the chart below.

| | | Identify by a Check | | |
|---|---|---|---|---|
| | | Brightest source | Widest source ↕ | Longest source ↔ |
| Name of light source | List all colors seen | | | |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |

3. Obtain the materials for the dark-line spectrum from your teacher. Arrange cards hottest to coldest. Cooler stars have many dark-line.

4. Obtain materials for bright line spectrum from your teacher. Work in groups of 3-4. One student should identify an element, place it on the wire and hold this into a flame. Other students should observe this with their spectroscopes and identify the bright lines. (Complete chart below.)

| Name of Element | Color of Bright Line |
|---|---|
| | |
| | |
| | |
| | |

# POINTS OF LIGHT

INTRODUCTION:

When you observe the night sky, you mostly see small white dots which you consider to be stars. Are you sure they are stars? They could be, but most of them are <u>not</u> individual stars and if you look closely many of them are not white! You will discover what's up there besides stars and what we know about these things.

OBJECTIVES:

Students will be able to do the following:

1. Explain why stars are different.
2. Identify the different kinds of galaxies.
3. Identify the characteristics of stars, galaxies, nebulae and other space objects.
4. Identify: magnitude, light year, nova and astronomical unit.

ACTIVITIES:

1. Using the *star window on the bulletin board, answer the questions on the star window lab page.
2. Answer the questions on Worksheet #3. Use your text and turn in.
3. Construct drawings and label each kind of galaxy. (Turn in)
4. Answer the questions on Worksheet #4. Use your text and turn in.
5. Obtain a set of galaxy cards from your teacher and identify each card as to the type of galaxy. (Have teacher check results.) Example #1 - spiral.
6. Research: Choose a topic and write several paragraphs about it. (Turn this in.) You may do another and it will count extra credit.

a. Betegeuse
b. Antaries
c. Sirius
d. Polaris
e. Pleiades
f. Horsehead Nebula
g. Crab Nebula
h. Magellanic clouds

EVALUATION:

In addition to completing the activities, this will consist of a short quiz. Study your lab pages, worksheets, and drawings. Refer to the objectives to check yourself.

## STAR WINDOW LAB PAGE

### Points of Light

1. Observe the star window and estimate the number of stars on our window.

2. Explain your procedure for obtaining your estimate.

3. List several ways the "stars" differ.

4. Since color indicates a star's temperature, list all colors you see and using your text write its approximate temperature.

5. Explain how we could classify (group or categorize) the stars.

6. List anything very different or odd that you see on the star window.

WORKSHEET #3

Points of Light

(Write answers below each question and turn this in.)

1. Explain why stars have different colors.

2. Write a rule for determining a star's color.

3. List the main elements that make up most stars.

4. What state of matter are most stars in - why?

5. List and describe a size classification for stars; use examples.

6. Explain the way stars move.

7. Given speed of light - 186,000 mps

   a. prove, show math, that light travels 6 trillion miles in one year.

   b. what is this called?

8. Explain magnitude of stars.

9. Explain how stars are different.

10. Define or explain:

a. Variable stars

b. Nova

c. Binary star

d. Astronomical unit

WORKSHEET #4

Points of Light

1. Describe in writing (include a diagram) our galaxy. (Mention size, shape, its name, etc.)

2. What is the name of a well known galaxy which is the closest one to ours.

3. Identify and describe the 3 types of galaxies.

4. Describe a nebula.

5. Identify, define, or explain:

   a. Nebulae

   b. Star clusters

   c. Coal sacks

   d. Quasars

# STAR PATTERNS

INTRODUCTION:

You may think that constellations are difficult to identify, but they're not, if you know what to look for, where and when to look. Can you identify the Big Dipper? Would you be interested in finding at least 4 other constellations? - on clear nights of course. Who, besides superman, can see stars when it is cloudy? You will find that identifying constellations and bright stars is easy and fun to do.

OBJECTIVES:

Students will be able to complete the following.

1. Identify the circumpolar, 12 zodiac and 4 seasonal constellations by sight and by naming them.
2. Explain how to locate stars and constellations given a star chart.
3. Identify prominent stars within constellations.
4. Explain how constellations received their names.
5. Define: constellation, circumpolar, pointers, star chart, age of Aquarius.
6. Explain why the 12 constellations were chosen for the zodiac.

ACTIVITIES:

1. Make a drawing of the circumpolar constellations and label each. (Turn in)
2. Answer questions on Worksheet #5. (Turn in)
3. Make a constellation card kit: use 3x5 cards and using dots construct outlines of constellations and identify it by writing names on the back of the card. Suggested constellations: 5 circumpolar, 4 each season. (Have your teacher check your set.)
4. Complete the matching page. (Self check it and show it to your teacher.)
5. Complete the star chart analysis. Obtain star chart from your teacher. (Turn in)
6. Research: Choose a topic and write several paragraphs about it. (Turn this in) You may do another one and it will count extra credit.

   a. zodiac signs
   b. horoscopes
   c. circumpolar whirls
   d. any constellations
   e. Greek mythology and the constellations

7. Extra Research: Take photographs (slides) of stars and share with the class.

EVALUATIONS:

In addition to completing the activities, this will consist of a short quiz. Study your kit for sight identification.

WORKSHEET #5

Star Patterns

(Write answers below each question and turn this in.)

1. Define:

   a. constellation

   b. circumpolar

   c. star chart

   d. pointers

   e. age of Aquarius

2. Explain in words and with a drawing how to locate polaris by using the pointers of the big dipper.

3. Name the 5 constellations we can see all year long and explain why we see them all year long.

4. Explain why we see different constellations in summer and winter.

5. Explain why the 12 particular constellations were chosen for the zodiac constellations.

6. Explain why there are two and sometimes three names for a constellation.

7. Explain how the constellations received their names.

MATCHING PAGE

| | |
|---|---|
| _____1. Aquarius | A. The Archer |
| _____2. Aries | B. The Big Dipper |
| _____3. Bootes | C. The Big Dog |
| _____4. Cancer | D. The Bull |
| _____5. Cassiopeia | E. The Crab |
| _____6. Cepheus | F. The Dragon |
| _____7. Cygnus | G. The Fish |
| _____8. Draco | H. The Goose |
| _____9. Gemini | I. The Herdsman |
| _____10. Hercules | J. The Hunter |
| _____11. Hydra | K. The King |
| _____12. Libra | L. The Lion |
| _____13. Orion | M. The Little Dipper |
| _____14. Pegasus | N. The Little Dog |
| _____15. Pisces | O. The Queen |
| _____16. Sagittarius | P. The Ram |
| _____17. Scorpio | Q. The Scales |
| _____18. Taurus | R. The Scorpion |
| _____19. Ursa Major | S. The Sea Serpent |
| _____20. Ursa Minor | T. The Strong Man |
| | U. The Swan |
| | V. The Twins |
| | W. The Water Carrier |
| | X. The Wife |
| | Y. The Winged Horse |

STAR CHART INVESTIGATION #1
-Analysis-

Answer the following questions as best you can.

1. Name the five (5) circumpolar constellations.
2. Name three (3) stars in the Big Dipper.
3. What are 3 differences between the Dippers?
4. What are the scientific names of the Dippers?
5. What is another name for the Dippers?
6. What does the constellation "Cepleus" look like?
7. Cassiopeia can appear as what 3 letters?
8. Polaris is known as what star?
9. Polaris is located in what constellation?
10. How bright is Polaris?
11. What is the magnitude of (a) Dubhe and Merah (b) Sirius (c) Vega (d) Bitilgeuse and Rigel in Orion (e) Most of the stars in the Big Dipper?
12. What kind of star is Cephei? (see legend)
13. The two brighest stars in Orion are?
14. When is a good time to see Orion? (Day)
15. Where is M42 and what is M42?
16. Name another variable star other than Cephei.
17. What is the name of the brightest star in Taurus?
18. Name the twin stars in Gemini.
19. Name 5 constellations you can see only during winter.
20. Name 5 constellations you can see only during summer.
21. In what month could you find Leo, the Lion?
22. What is the brighest star found on this chart?
23. How bright is Altair?
24. About how many stars are shown on this chart?
25. Name a nebula, cluster or galaxy shown on this chart.

# SOLAR SYSTEM - THE SUN

INTRODUCTION:

A solar system is a group of objects orbiting a central mass which we will call the sun. Ancient civilizations had other names for the sun. Do you know any of them? The sun is a star just like the stars we see at night - why is it that we know more about the sun than we know about the stars?

OBJECTIVES:

Students will be able to do the following.

1. Compare the sun to other stars.
2. Identify the sun's surface features.
3. Identify the layers which make up the sun.
4. Distinguish between fast and slow sun time.
5. Tell time with a sun dial.
6. Explain how the Analemma works and its purpose.

ACTIVITIES:

1. Obtain data page for lab titled H-R Diagram. Answer the questions on your worksheet and turn this in.
2. Answer the questions on Worksheet #6. Turn this in.
3. Assemble the sun dial. Show it to your teacher. Also, write a paragraph explaining how it works. Turn this in.
4. Complete the lab titled "Analemma Dilemma". Turn this in. (Obtain data page from your teacher.)
5. Research: Choose a topic and write several paragraphs about it. Turn this in. You may do another and it will count extra credit.

   a. sun burn
   b. tower telescopes
   c. Aurora's
   d. sun dials
   e. Einstein
   f. vertical ray

6. Extra Research: Complete the lab titled "Measuring the Sun's Diameter". Get materials and instructions from your teacher.

EVALUTION:

In addition to completing the activities, this will consist of a short quiz. Study your worksheet and lab pages. Refer to the objectives to check yourself.

## H-R DIAGRAM

Using the information on temperature and luminosity, graph data, showing the positions of the 20 brighest stars and the 20 nearest stars. Plot the brighest stars using a red pencil or the symbol * . Plot the nearest stars using a blue pencil or o.

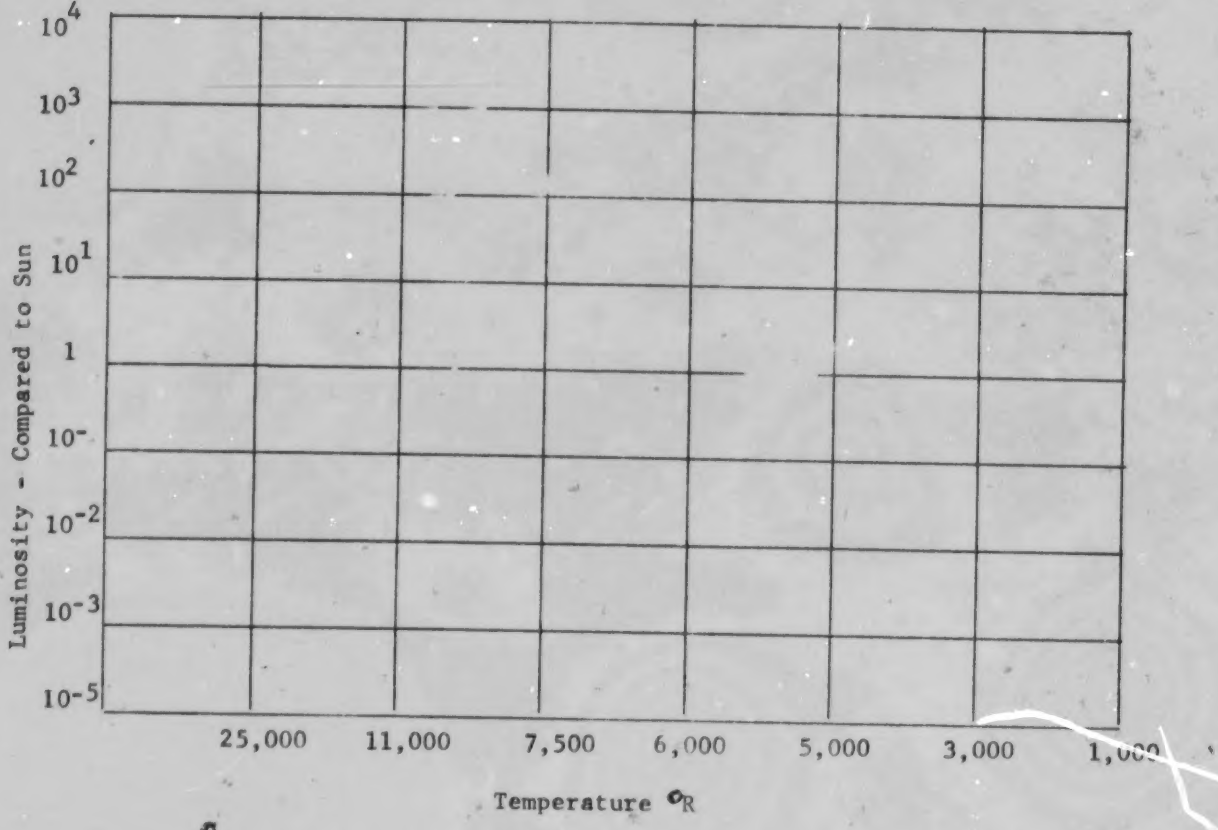
1. How do the positions of these stars compare with the positions of most stars on the H-R diagram?
   _____

2. Compare the sun to the 20 brightest stars with reference to luminosity _____ temperature _____.

3. Compare the sun to the 20 nearest stars with reference to luminosity _____ _____ temperature _____.

4. Compare the H-R positions of the brighest stars to those of the nearest stars
   _____
   _____
   _____

5. How does the sun compare to other stars on the H-R diagram? _____
   _____



WORKSHEET #6

Solar System - The Sun

(Write answers below each question and turn this in.)

1. Identify instruments used to study the sun and explain what each does.

2. Construct a drawing of the sun, label the layers and list 2 things about each.

3. Explain the cause of sunspots and the sunspot cycle.

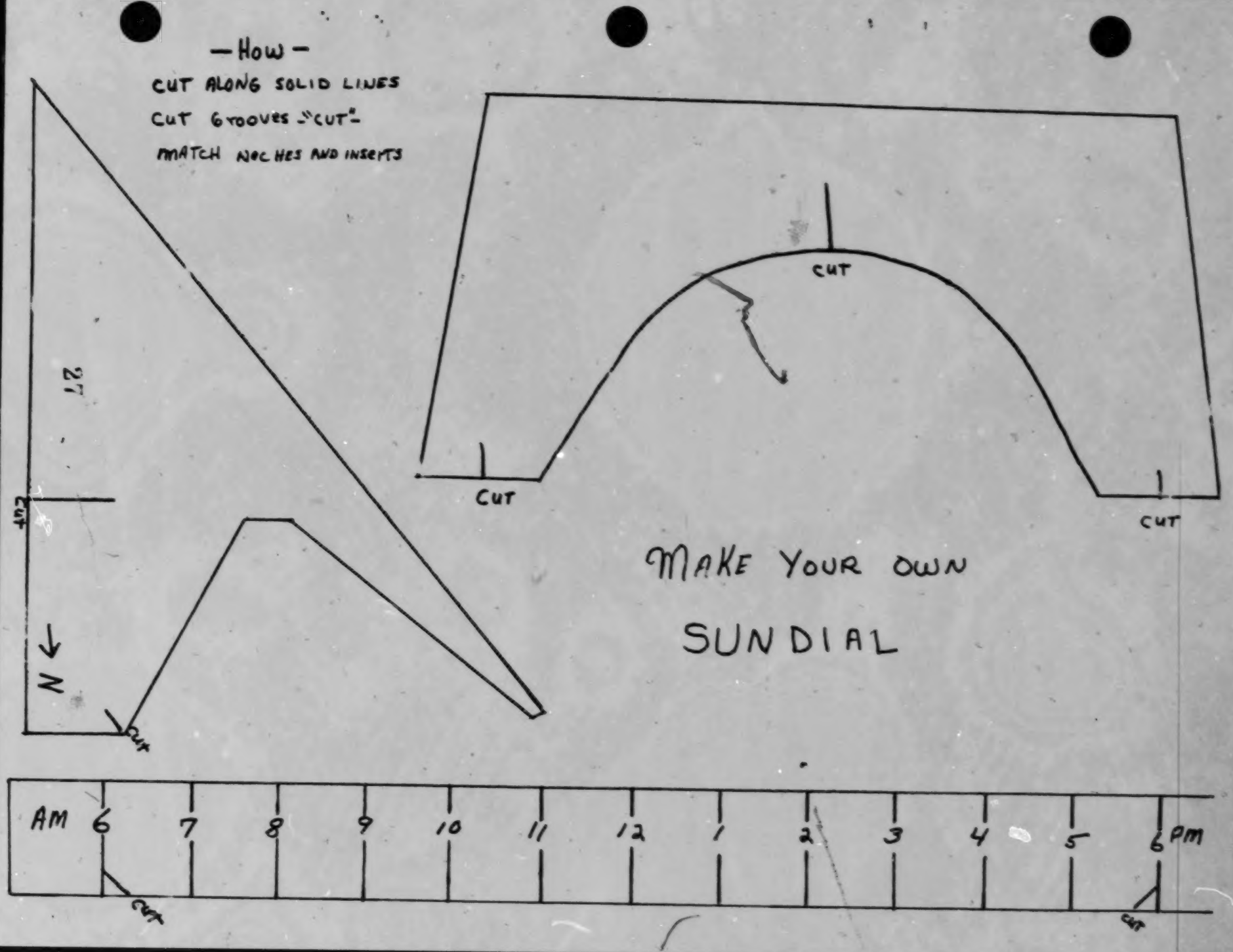
4. Describe effects on earth resulting from solar disturbances.

5. Briefly explain how the sun makes its energy.

6. Identify, define or explain:

   a. solar flares

   b. solar prominences


— How —
CUT ALONG SOLID LINES
CUT GROOVES "CUT"
MATCH NOCHES AND INSERTS
12
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CUT
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MAKE YOUR OWN
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WORKSHEET

Analemma Dilemma

Instructions!

The Analemma enables you to determine the correct solar time for your area. You can also locate the sun's vertical ray on any given day. The top of the chart is divided so that one side shows the number of minutes the sun is fast or slow. Slow sun time refers to the number of minutes that the sun crosses your meridian (position) before 12 o'clock noon. When the sun is slow, it has not reached its highest point, but it will. Fast sun time refers to the number of minutes that the sun crosses your meridian after 12 o'clock noon. The sun was overhead prior to 12 o'clock noon. Notice the numbers in the middle of the figure 8, they show the latitude of the sun's vertical ray on any particular date.

Complete the following questions: (use your text and the Analemma Data Page)

1. What is the figure 8 called?

2. Explain fast and slow sun time.

3. Determine the dates when the sun is not fast.

4. Determine the maximum number of minutes the sun is fast and slow.

5. Determine the sun's declination for the winter and summer solstice and the normal and autumnal equinoxes!

6. Determine the sun's declination on the following dates:

   a. September 1st
   b. February 7th
   c. January 30th
   d. March 5th
   e. May 10
   f. July 4th
   g. June 13th
   h. August 20th
   i. April 20th
   j. November 30th

7. Determine the number of minutes the sun is fast or slow on the following dates:

a. June 20th

b. January 30th

c. November 5th

d. August 15th

e. April 22nd

f. October 1st

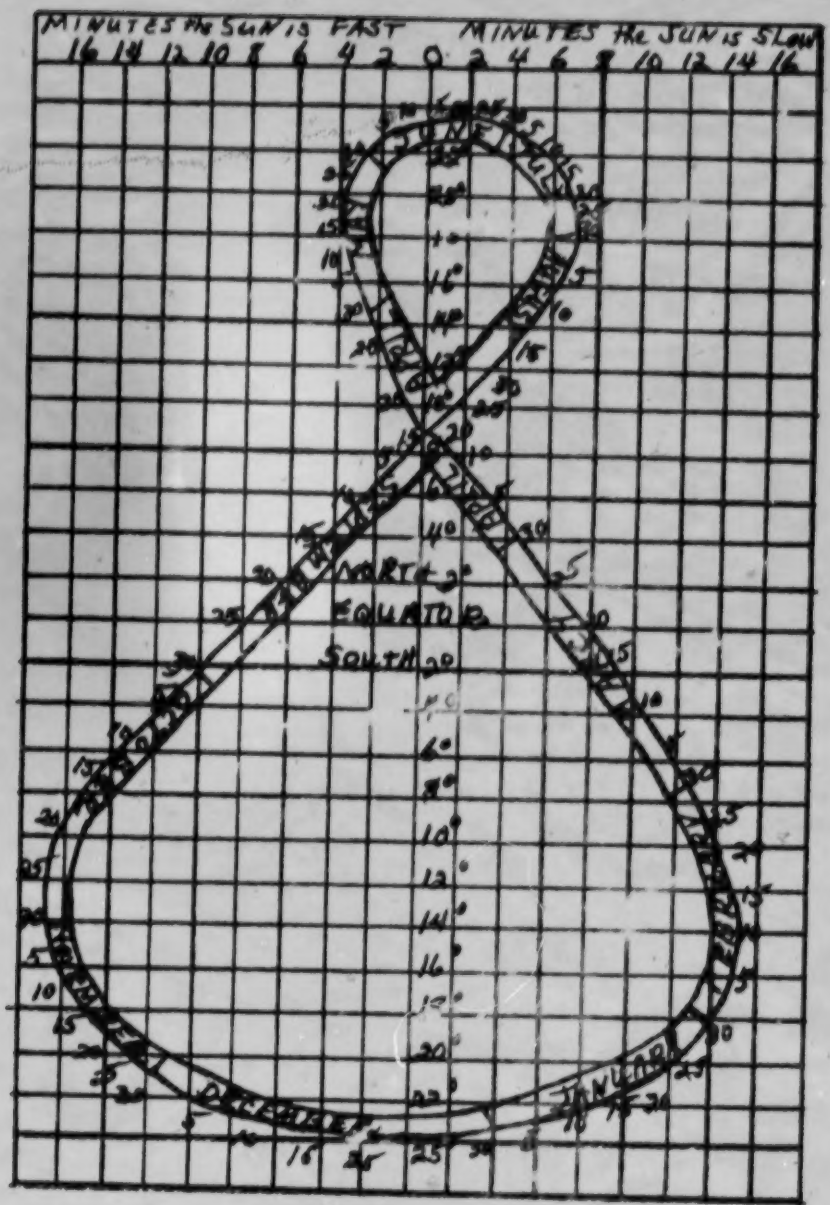
g. July 30th

h. March 10th

i. September 18th

j. October 25th

8. Give the time of actual solar noon at your locality for the dates above.


MINUTES the SUN is FAST
MINUTES the SUN is SLOW
16 14 12 10 8 6 4 2 0 2 4 6 8 10 12 14 16
NORTH
EQUATOR
SOUTH

## SOLAR SYSTEM: THE PLANETS

INTRODUCTION:

Large bodies orbiting around the sun are called planets. Can you name all of the planets? How many are there in our solar system? Could there be another one? Since you live on planet earth, you know a lot about it, but how much do you know about the other planets?

OBJECTIVES:

Students will be able to complete the following.

1. Identify planets by their various characteristics.
2. Identify the shape of a planet's orbit.
3. Explain how Bodes Law relates to planets.
4. Identify the planets by name on a diagram.

ACTIVITIES:

1. Complete the chart on planet information. Use several earth science texts and show it to your teacher.
2. Using the chart above answer the questions on the page titled "How Well do you Know the Planets?". Turn this in.
3. Construct a top view diagram of the planets. Use a text and show your results to your teacher.
4. Do the lab titled "Discover the Shape of a Planet's Orbit". Use text, Exploring Earth Science, page 180. Obtain materials from your teacher and show him your results.
5. Do lab titled "Planet X". Follow instruction sheet carefully and show results to your teacher.
6. Do lab titled "Relative Distance Diagram of the Planets". Show your results to your teacher.
7. Research: Choose a topic and write several paragraphs about it. (Turn this in.) You may do another and it will count extra credit.
   a. meteors and meteorites
   b. comets and Halley's Comet
   c. fireballs
   d. life on other planets

EVALUATION:

In addition to completing the activities, this will consist of a short quiz. Study your charts papers and lab pages. Refer to objectives to check yourself.

## Chart of Planetary Information

Using your notes, textbooks, fill in all portions of the chart below.

| Name of Planets | Diameter | Millions of Miles from Sun | Surface Temp. | Period of Rotation | Period of Revolution | Number of Satellites | Atmos. Contains | Astronomical Units |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |
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## How Well do you Know the Planets?

1. Name of the red planet?
2. Name of the smallest planet?
3. Name of the hottest planet?
4. Name of the messenger planet?
5. Name of the war planet?
6. Name of the ringed planet?
7. Name of the closet plane to the sun?
8. Name of the fartherest planet from the sun?
9. Name of the planets with the shortest day?
10. Name of the planet similar to earth?
11. Name of the planet with the longest day?
12. Name of the coldest planet?
13. Name of the planets with $H_2O$ (water)?
14. Name of the inner planets?
15. Name of the largest planets?
16. Name of the blue planet?
17. Name of the twin planets?
18. Name of the brighest planet as seen from earth?
19. Name of the closest planet to earth?
20. Name of the planet with ice caps?
21. Name of the planetwith life?
22. Name of the planet with phases?
23. Name of the planet with two moons?
24. Name of the planet with 12 moons?
25. Name of the planets in order from sun to Pluto.

# Planet X

Objectives:

1. To determine the significance of Bodes Law and by using it, explain where a missing planet might exist or have existed.

Procedure:

1. Number 1-9 across your paper, spacing equally the numbers.

2. Label the 9 planets, 1 would be Mercury, etc., to 9 = Pluto.

3. Using information from your chart and a correct value for one Astronomical Unit, determine the A.V. for each planet. Earth is, of course, 1. Put this number below the planet's name.

4. You should also list the number of miles (in millions) below this number in #3.

Questions:

5. Describe relationships or patterns which exist in the A.V. Line.

6. Determine where a break in sequence or a gap in the A.V. Line occurs. What might this be? Refer to scale drawing chart.

7. Calculate the approximate distance in millions of miles and A.V.'s for Planet X which might lie beyond Pluto.

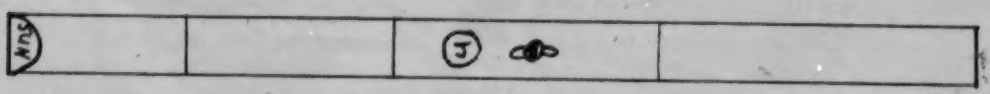
## Relative Distance Diagram of the Planets

Materials:

several sheets of paper
rulers
scissors
tape
chart of planetary distance

Procedures:

1. Scale = 1" = 100 million miles
2. Cut your paper into 4" wide strips. They should be about 10-11 inches long.
3. Tape all 4 pieces together into a continuous band or ribbon.
4. Begin on the left and draw a semi-circle having a 2" radius to represent the sun (see below).




5. Measure off with the ruler the relative distance to the planets from the edge of your sun.
6. Make a small circle or other figure to illustrate a planet. Use rings, etc., on Saturn.
7. How many inches or miles was it to Pluto?
8. Locate Asteroid Belt, using dots.
9. Put moons on for each planet.
10. At extreme right of chart put this information:
    a. title - see above
    b. scale - see procedure #1
    c. your name and section

# SOLAR SYSTEM - THE MOON

INTRODUCTION:

Have you seen a picture of the moon's surface? Did it look like earth's surface? Why? In what ways does the moon affect earth?

OBJECTIVES:

Students will be able to complete the following:

1. Compare moon to earth.
2. Describe lunar surface features and a possible origin for their existence.
3. Explain why the moon has phases.
4. List and describe the moon's phases.
5. Explain how the moon causes eclipses.
6. Describe the kinds of eclipses.

ACTIVITIES:

1. Complete the page titled "Comparing the Moon to the Earth". Use your text and turn this in.
2. Complete Worksheet 7. Use your text and turn this in.
3. Lunar Familization Lab.
   a. Using a lunar map, label the blanks on the page titled "Near Side of the Moon".
   b. Using above page and "Far Side of the Moon" page, write a comparison of the sides. Turn both pages in.
4. Obtain a lunar model and write a good descriptive paragraph about it. Mention all features shown. Turn this in.
5. Complete lab page titled "Understanding Moon Motions - 1". Obtain page "Moon-phase Data" from your teacher. Turn this in.
6. Complete lab page titled "Understanding Moon Motions - 11". Obtain data page from your teacher.
7. Research: Choose one below and complete it. You may do the other for extra credit.
   a. Identify (by names) the moons of the other planets.
   b. Moon problem puzzle. (Obtain from your teacher.)

EVALUATION:

In addition to the above activities, this will consist of a short quiz. Refer to the objectives. Study your worksheets and lab pages.

Name _____ Date _____

# COMPARING THE MOON TO THE EARTH

1. On the back of this paper, define: apogee, perigee, Synodic, sidereal, and all the terms listed in the left column of this page, except mass.

2. In the blanks provided, record the appropriate Earth data.

| | MOON | EARTH |
|---|---|---|
| diameter | 2,160 miles | |
| volume | 1/49 that of Earth | |
| mass | 1/81 that of Earth | |
| density | 3.3 times that of water | |
| surface gravity | 1/6 that of Earth | |
| velocity of escape | 1.5 miles per second | |
| velocity of motion | 2,287 miles per hour | |
| | 3,350 feet per second | |
| distance from Earth | 252,710 miles at apogee | |
| | 221,463 miles at perigee | |
| | 238,857 miles, mean distance | |
| revolution period | 29d 12h 44m 2.8s (synodic) | |
| | 27d 7h 43m 11.5s (sidereal) | |
| rotation period | 29d 12h 44m 2.8s (synodic) | |
| | 27d 7h 43m 11.5s (sidereal) | |
| stellar magnitude | −12.8 | |
| albedo | 0.07 | |

3. The reason that the Earth's surface is not so pitted as is the moon's surface is because the Earth's surface is not so likely to be hit by meteorites. Do you agree with this statement? _____ Explain on the back of this sheet.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WORKSHEET #7

1. Terms to define. Write answers on your own paper.

a. Selenography
b. Man in the moon
c. Waxing moon
d. Waning moon
e. Phases of the moon
f. Earth shine
g. Moon shine
h. Sidereal month
i. Synodic or lunar month
j. Umbra and penumbra
k. High and low tides
l. Nesp and spring tides

2. Explain how these lunar features could have formed.

a. Lunar seas

b. Mountain ranges

c. Craters

d. Rays

e. Rills

3. Describe the moon's orbit around earth.

4. Explain why we see only 1 side of the moon when it revolves and rotates.

5. Explain why we see different phases of the moon. List all 8 phases.

6. Explain why we have lunar and solar eclipses and annular eclipses. Draw each.

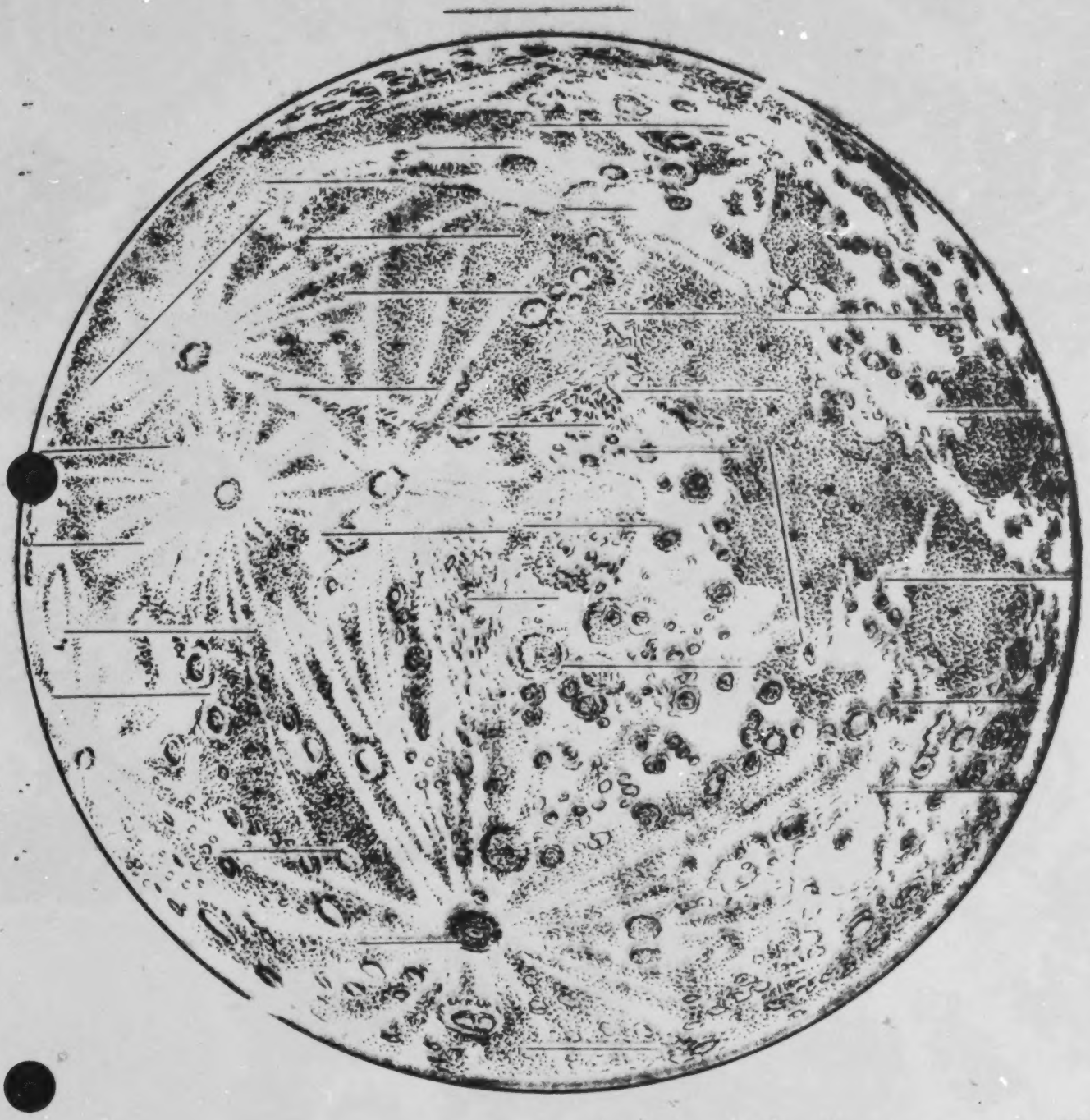
7. Explain why we do not have an eclipse every month.

8. Explain the moon's effect on tides.

Name _____ Date _____

# NEAR SIDE OF THE MOON

[illegible] the physical features of the moon as indicated by the blanks.



SATELLITES—NATURAL AND ARTIFICIAL

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Name _____ Date _____

# FAR SIDE OF THE MOON

Compare this labeled illustration of the far side of the moon, to the Luna 3 and Apollo 8 photographs. Use a red or dotted line to separate the section illustrated on this map that was not photographed by Luna 3. Use a blue or broken line to separate the section illustrated on this map that was not photographed by Apollo 8.

SATELLITES—NATURAL AND ARTIFICIAL

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Name _____ Date _____

## UNDERSTANDING MOON MOTIONS—I

Shade each of the moon models to show how the moon would appear to earth on the indicated day of the moon cycle. Also label each model: 1) waxing or waning; 2) gibbous, crescent, new moon, full moon, first quarter, third quarter.

First

Third

Fifth

Eighth

Tenth

Twelfth

Fifteenth

Seventeenth

Nineteenth

Twenty-second

Twenty-fourth

Twenty-sixth

Twenth-nineth

Is a full moon ever visible at noon? _____ Explain: _____

_____

_____

_____



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Name _____ Date _____

## UNDERSTANDING MOON MOTIONS—II

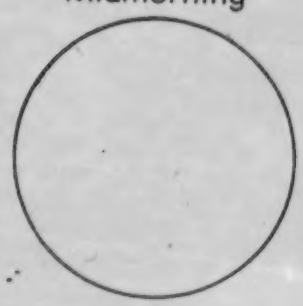
Refer to page 3A, Moon Motions. The arrows from the earth model to each of four moon models indicates the time the moon rises at each of those four phases. The moon sets about twelve hours after it rises.

1. When does a new moon rise? _____ ...set? _____
2. When does a first quarter moon rise? _____ ...set? _____
3. When does a full moon rise? _____ ...set? _____
4. When does a third quarter moon rise? _____ ...set? _____
5. Is a gibbous moon that is waxing visible in the evening? _____
6. Is a gibbous moon that is waning visible in the evening? _____
7. Is a crescent moon that is waxing visible in the evening? _____
8. Is a crescent moon that is waning visible in the morning? _____
9. Pose and answer a question similar to the ones above: _____

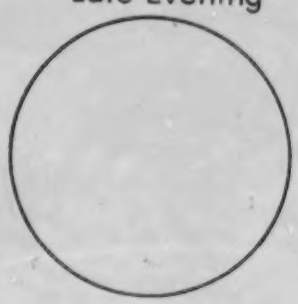
_____ _____

10. Shade the models of the moon as it would appear if it rises at each of the times labeled: Label whether waxing or waning. Give approximate day of moon cycle.

Midmorning



Late Evening



Dawn

Dusk

Midnight

Midafternoon

Predawn

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# TIME ZONES

INTRODUCTION:

You all can tell time by looking at clocks. What did we use before clocks existed? Is it the same time across the U.S.? or even the world? Why do we have different times? We will explore these timely problems.

OBJECTIVES:

Students will complete the following:

1. Identify the time zones for the U.S.

2. Solve time zone problems for the U.S. and world situations.

ACTIVITIES:

1. Complete Worksheet #8. Use your text. Turn this in.

2. Obtain the time zone map from your teacher. Use it to solve the problems on the time zones lab page.

3. Using the above map - complete lab pages titled "Using Greenwich Mean Time" and "The International Date Line".

4. Research: Choose a topic from the list below and write several paragraphs on it. Turn this in. You may do another for extra credit.

   a. Calendars (Roman, Julian, World)

   b. International Date Line

   c. Time Devices (past and present)

EVALUATION:

In addition to the above activities, this will consist of a short quiz. Refer to objectives and study your worksheet.

WORKSHEET #8

Define or describe:

1. Day

2. Year

3. Month

4. Hour

5. Minute

6. Second

7. Astronomical day

8. Sidereal day

9. Apparent solar day

10. Apparent solar noon

11. Mean solar day

12. Mean solar time or civil time

13. Equation of time

14. Analemma

15. Local time

16. Standard time

17. Standard time zone

18. Daylight saving time

19. International Date Line

20. Universal time

# Time Zone Problem Page

U.S. Problems

1. What time is it in Chicago if it is 3 p.m. in New York City?
2. If it is 12 noon in Los Angeles, what time is it in New York?
3. The time is midnight in the Rockies, what time is it in Frederick?
4. If we are eating lunch at 11 a.m., what time is it in Los Angeles?
5. Will Hagerstown and Frederick have the same apparent solar time?
6. If it is 9 a.m. in St. Louis, what time is it in Frederick?
7. How many hours difference is their between friends who are 30 degrees of Longitude apart?
8. If you are going to call this friend at 7:30 his time, what time would you have to call him from your Frederick residence?
9. If it is 2 p.m. in Salt Lake City, what time is it in Washington, D.C.?
10. If your longitude is 100 degrees west, what time zone are you in?
11. Why are the time zone lines crooked lines?

World Time Problems

12. How many hours difference in time is Frederick from Greenwich?
13. If it is noon in Greenwich, England, what time is it in Frederick?
14. If it is 10 a.m. in Frederick, what time is it in Peking?
15. Flying from New York City to Tokyo involves a time change of how many hours?
16. If your time is 6 hours earlier than Greenwich time, your longitude is?
17. As you travel from Frederick to Honolulu, you must change your watch - which way earlier or later and how many hours?
18. If the Russians in Volgograd are listening to Laugh-In which is on at 8 p.m. on Monday, what time and day is it in Volgograd?
19. If you are calling your girl friend who resides in Frederick from South Viet Nam and it is 8:15 p.m. there, what time is it in Frederick? Is it the same day?
20. If it is 7 a.m. in Frederick, what time is it half way around the world?
21. Bonus - Make up your own time problem and solve it.

Name _____ Date _____

## USING GREENWICH MEAN TIME

**Greenwich Mean Time**—GMT (sometimes called International Time) is the standard of time as designated at the observatory near Greenwich, England.

If you know when an event occured according to GMT, you can use a Standard Time Zone Map to determine the time in any given city. The numbers below each zone tell you how many hours to add or subtract from GMT.

EXAMPLE: Denver is 7 hours behind GMT. If an event occured at 1:00a.m.GMT, it was 6:00 p.m. ( 7 hours earlier ) according to local time in Denver.

The cities designated on the Standard Time Zones Map and the hours (plus or minus) of deviation are listed below. Write the name of each city in the proper place on your map.

| | | |
|---|---|---|
| Sverdlovsk, USSR . . . . . +4 | Petropavlovsk, USSR . . . +11 | New Orleans . . . . . −6 |
| Karachi, Pakistan . . . . . +5 | Wellington, New Zealand +12 | Washington, D.C . . . . . −5 |
| Delhi, India . . . . . +6h 30 m | Nome, Alaska . . . . . −11 | Santiago, Chile . . . . . −4 |
| Urumchi, NW China . . . . . +8 | Honolulu, Hawaii . . . . . −10 | Brasilia, Brazil . . . . . −3 |
| Ulan Bator, Mongolia . . . . +8 | Fairbanks, Alaska . . . . . −10 | London, England . . . . . ±0 |
| Hanoi, North Vietnam . . . +7 | Whitehorse . . . . . −8 | Oslo, Norway . . . . . +1 |
| Peking, China . . . . . +8 | San Francisco . . . . . −8 | Capetown, Africa . . . . . +2 |
| Tokyo, Japan . . . . . +9 | Denver . . . . . −7 | Volgograd, USSR . . . . . +3 |
| Sydney, Australia . . . . . +10 | Winnipeg . . . . . −6 | Mecca, Saudi Arabia +3h 30m |

1. If it is 8:00 a.m. GMT, what time is it in Hanoi? _____
2. If it is 6:00 p.m. GMT, what time is it in Honolulu? _____
3. Pose and answer a problem similar to the two above.

_____

_____

Use the Standard Time Zones Map to determine time differences between any two cities.

**Count ahead one hour for each time zone crossed to the east:** Example: When it is 6:00 a.m. in San Francisco, it is 9:00 a.m. in Washington D.C. because Washington D.C. is 3 time zones east of San Francisco.

**Count back one hour for each time zone crossed to the west:** Example: When it is 5:00 p.m. in Oslo, it is 11:00 a.m. in Washington D.C. because Washington D.C. is 6 time zones west of Oslo.

4. If it is 3:00a.m., in Fairbanks, what time is it in Sidney? _____
5. If it is 3:00a.m., in Brasilia, what time is it in Capetown? _____
6. Pose and answer a problem similar to the two above.

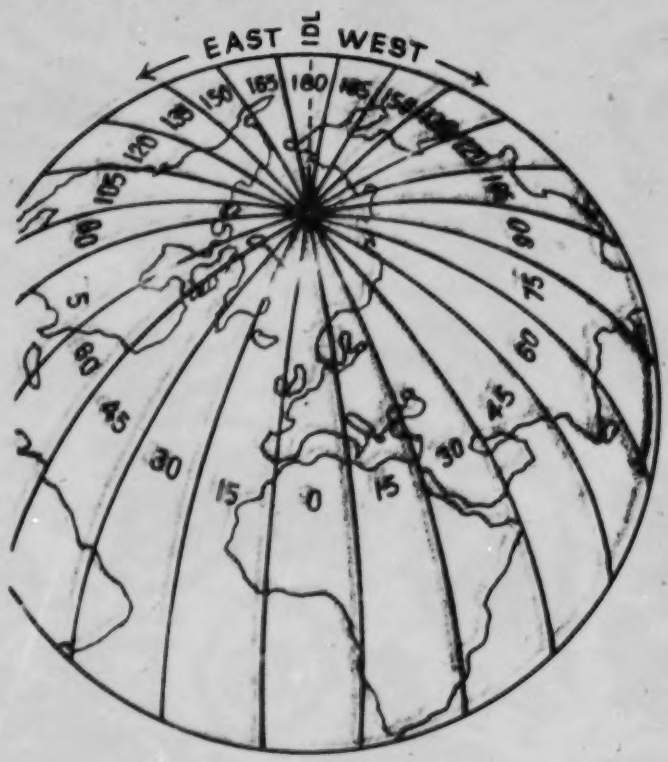
_____

_____

Name _____ Date _____

# THE INTERNATIONAL DATE LINE

The 180th meridian has been designated as the **International Date Line.** It is here that each new day begins. The west side of the International Date Line is a day ahead of the east side of the International Date Line. For example: When it is 4:00 Sunday morning in western Alaska and Hawaii, it is 3:00 Monday morning in eastern Asia and New Zealand.




1. At what moment each day is the whole world on the same day? _____

_____

2. At all other times, there are two lines on the earth where dates change. What are they? _____

_____

3. If it is 9:00 a.m. Friday, in Denver, it is _____ in Sidney.
time and day

4. If it is 3:00 p.m. Sunday, in Oslo, it is _____ in Tokyo.
time and day

5. Pose and answer a problem similar to numbers 4 and 5 above. _____

_____

6. You have won a contest including prizes of a trip to Japan and $1,000,000 tax free and payable to you in Tokyo at exactly midnight, Thursday, January 29 (Tokyo time). You depart San Francisco at 8:00 a.m. Thursday (San Francisco time). The flight takes eleven hours. When you arrive in Tokyo, you are refused your $1,000,000.

Explain why: _____

_____

_____

_____



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# EARTH AND SPACE LOCATIONS

INTRODUCTION:

You can probably find your town on a map but can you identify its latitude and longitude? There are special maps of the sky which we can use. How do astronomers locate stars and constellations on this map?

OBJECTIVES:

Students will complete the following:

1. Explain how latitude and longitude function on earth.
2. Solve earth location problems.
3. Explain Right Ascension and Declination.

ACTIVITIES:

1. Complete Worksheet #9. Turn this in.
2. Using an atlas, solve the problems on the page titled "Place Locations using Latitude and Longitude". Turn this in.
3. Complete lab titled "Coordinate Determination Exercise". Turn this in.
4. Complete lab titled "Circumpolar Constellation Locations". Obtain data page from your teacher. Set up data page according to teacher's example. Turn this in.

WORKSHEET #9

Terms: Earth Locations

1. Parallels

2. Meridians

3. Latitude

4. Longitude

5. Equator

6. Prime Meridian

7. Tropic of Cancer

8. Tropic of Capricorn

Fig. 1 - Label meridians and parallels

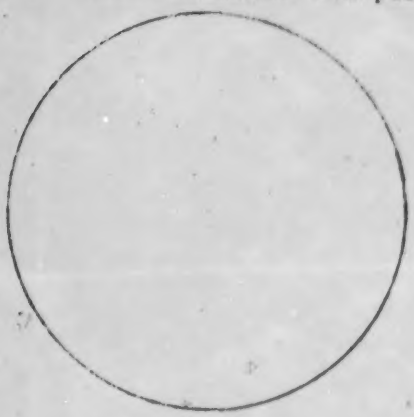


Fig. 2 - Label major places on earth

WORKSHEET #9

Terms: Space Locations

1. Celestial sphere

2. Celestial equator

3. Celestial poles (N-S)

4. Declination

5. Right ascension

6. Vernal equinox

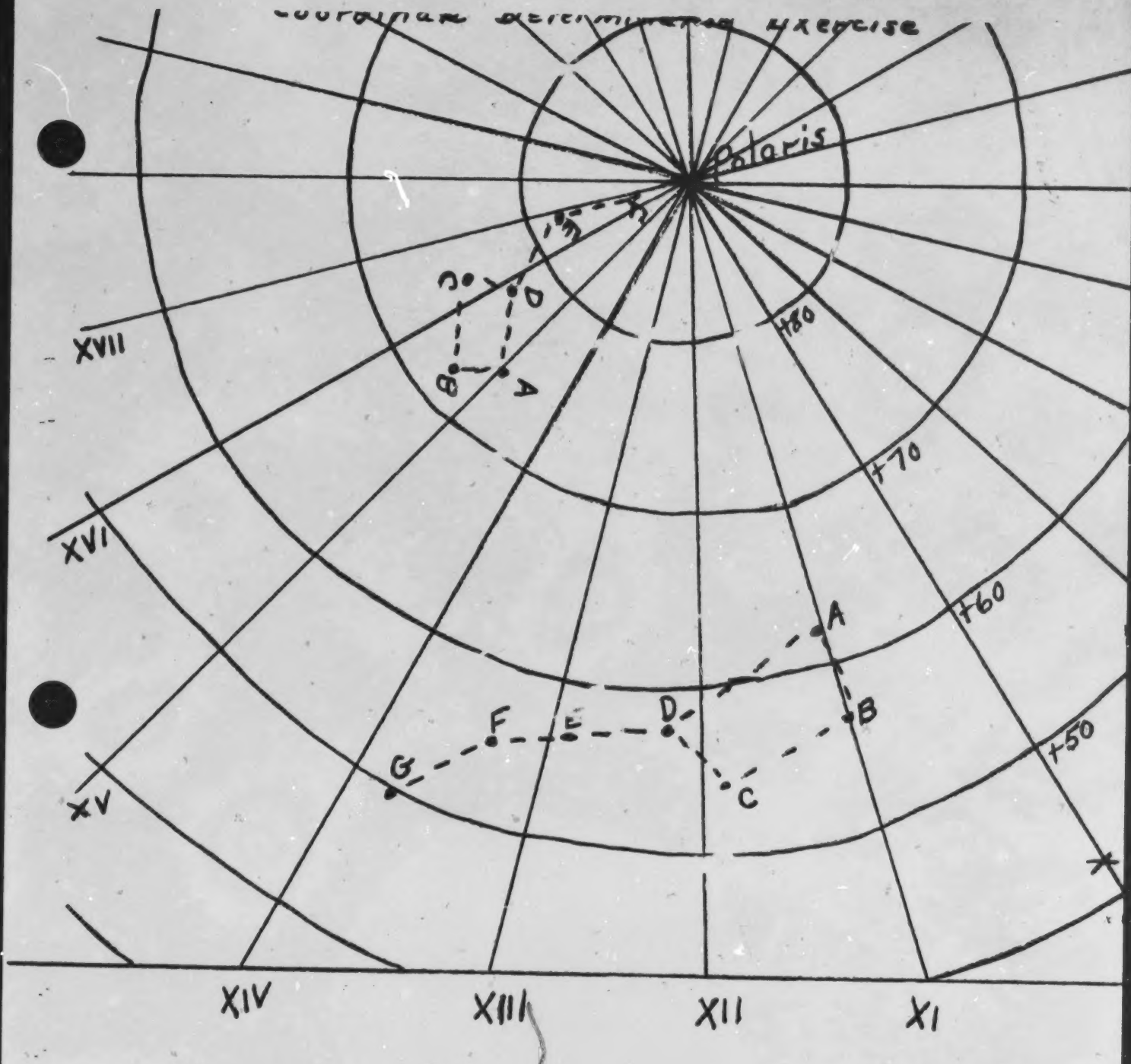
7. Coordinates

Fig. 3 - Label above terms

## Place Locations Using Latitude and Longitude

Directions: You will be given a Latitude and Longitude for one particular place. Using your world map locate the areas near that place and then with the Atlas find the name of the place. For example: Lat. = 42° N and Long. = 89° W is in central Northern U.S. so you need to find a map showing the central N. states and you will find that Chicago is approximately at that location. Confine your answers to major cities.

| | Lat. | Long. | Place |
|---|---|---|---|
| 1. | 49° N | 2.5° E | _____ |
| 2. | 59° N | 18° E | _____ |
| 3. | 23° S | 43° W | _____ |
| 4. | 33° 30' N | 87° W | _____ |
| 5. | 35° N | 90° W | _____ |
| 6. | 9° N | 79° 30' W | _____ |
| 7. | 44° 30'N | 26° E | _____ |
| 8. | 55° N | 83° E | _____ |
| 9. | 47° 30' N | 19° E | _____ |
| 10. | 48° 20'N | 16° 20' E | _____ |
| 11. | 34° S | 71° W | _____ |
| 12. | 0° N S | 90° W | _____ |
| 13. | 4° 30'N | 74° 10' W | _____ |
| 14. | 27° N | 80° W | _____ |
| 15. | 38° S | 145° E | _____ |
| 16. | 30° N | 32° E | _____ |
| 17. | 16° N | 17° W | _____ |
| 18. | 15° N | 23° 30' W | _____ |
| 19 | 19° S | 47° E | _____ |
| 20. | 2° N | 104° E | _____ |
| 21. | 56° N | 37° E | _____ |
| 22. | 42° N | 13° E | _____ |
| 23. | 52° N | 4° 30' E | _____ |
| 24. | 39° 40' N | 77° 30' W | _____ |
| 25. | 39° 30' N | 76° 30' W | _____ |
| 26. | 21° 30' N | 158° W | _____ |
| 27. | 12° S | 77° W | _____ |
| 28. | 90° S | 0 | _____ |
| 29. | 50° S | 140° W | _____ |
| 30. | 34° N | 118° W | _____ |
| 31. | 40° | 105° W | _____ |
| 32. | 38° N | 90° W | _____ |
| 33. | 29° N | 87° W | _____ |

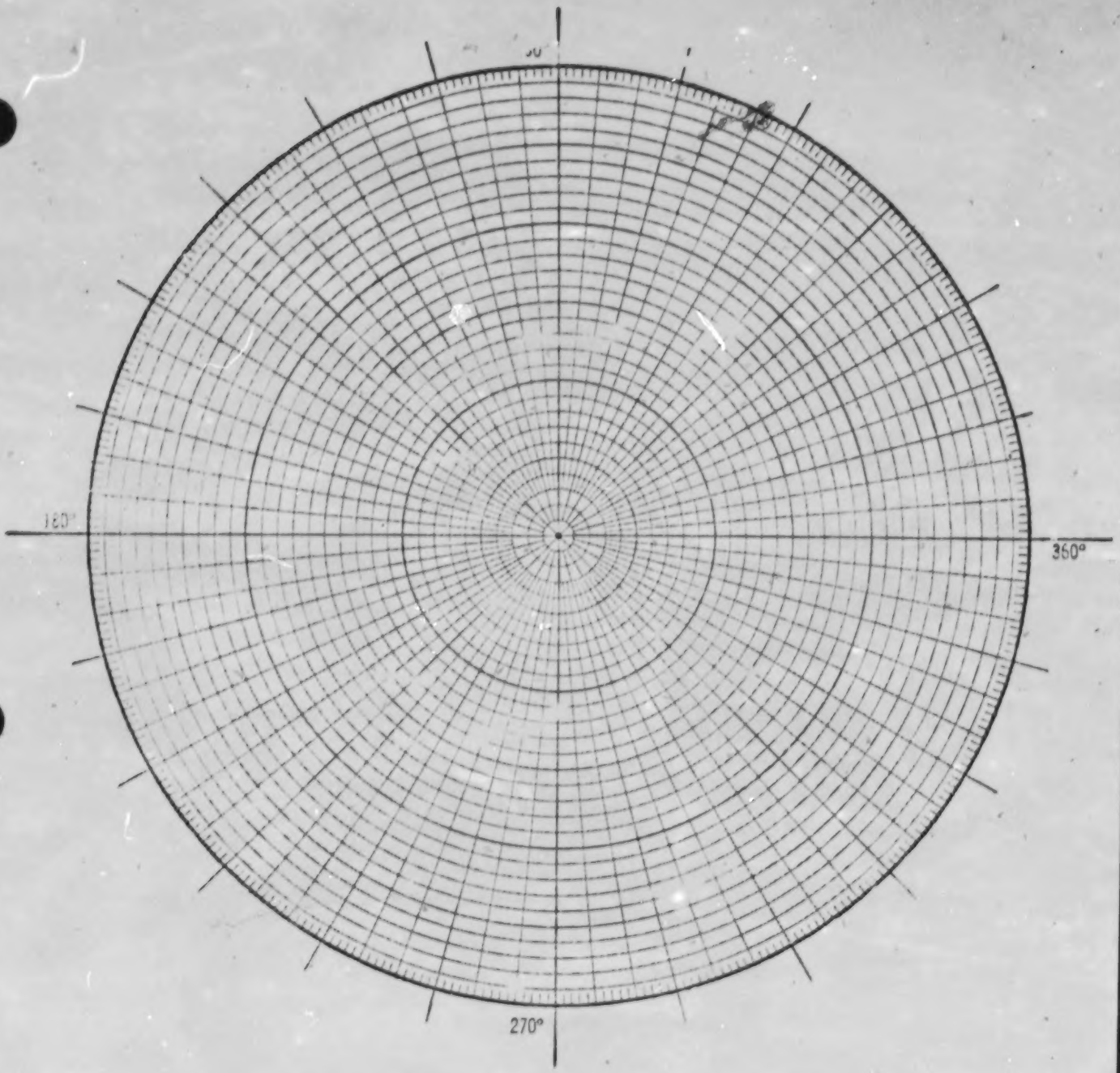



Determine the coordinates of Ursa Major.

Mark the location of the following objects.

| | | | | | | |
|---|---|---|---|---|---|---|
| M 97 | R.A | 11 hr. | 12 m | Dec | + | $55^{\circ}$ |
| M 101 | R.A | 14 hr. | 02 m | Dec | + | $54^{\circ}$ + 30' |
| M 51 | R.A | 13 hr. | 28 m | Dec | + | $47^{\circ}$ + 27' |
| M 81 | R.A | 9 hr. | 51 m | Dec | + | $69^{\circ}$ |

Determine the coordinates of Ursa Minor.

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General Information

There are 8 sub-units in this course. Each has an introduction, objectives and a list of activities accompanied by the lab pages and worksheets. There are notes in the teacher's section which correlates to the same topic in the student section. The teacher's section identifies the necessary pages for the students. Pages which can be used as handouts, sample quizes, and suggestions are explained in the teacher's section. A sample evaluation is included in some instances, however, it is recommended that the teacher devise his own evaluation. In addition to the quizes, a checklist is recommended to keep track of what is completed as well as graded.

You need not teach this course in its entirety. You could utilize any sub-unit or several of them without doing it all.

There are many films, filmstrips and study prints which are available at the IMC. It is suggested that they are previewed and used when you feel they are most appropriate. The planetarium is available for activity-oriented lessons which could be used with various topics in this course.

There are various teaching methods which should be employed throughout this course. Class discussions for instance have not been included as an activity, mainly because each teacher should plan the day to day approach as to how he wishes to teach the topic. It should be remembered that is only an attempt to foster independent study for our students.

Detailed Information

ASTRONOMICAL INSTRUMENTS

a. spectroscope instruction sheet included (see materials - main item diffraction grating - can get from Edmond Scientific)

b. dark-line spectrum cards - ESCP kit

c. bright-line spectrum kit - IET kit

d. sample quizes included in this section

e. worksheets 1-2 in student section

POINTS OF LIGHT

a. Construct star window by cutting out circles and punching dots and pasting them on black paper. It will represent night sky.

b. galaxy card kit - ESCP kit

c. There are slides of galaxies available through Wards for the galaxy and nebula study pages.

d. sample quizes included

e. worksheets 3-4 in student section

STAR PATTERNS

a. Make available a circumpolar star chart for student use.

b. worksheet 5 matching page in student section

c. Have students obtain 3x5 cards or cut paper about that size. Pictures of seasonal and zodiac constellations available at planetarium. Also on numerous charts.

d. Star chart lab page is adapted from northern sky star chart available from Wards.

e. sample quiz included

SOLAR SYSTEM - SUN

a. Make available Data page for H-R Diagram.

b. The H-R lab page, worksheet 6, sun dial and analemma dilemma are included in student section.

c. Have lab materials and instructions available for extra research.

SOLAR SYSTEM - THE PLANETS

a. Student section includes chart of planet information, page titled "How Well do you know the Planets", lab page - Planet X, lab page titled "Relative Distance Diagram".

b. Teacher section includes sample quizes.

SOLAR SYSTEM - THE MOON

a. Students have pages, Comparing Earth to Moon, worksheet 7, Near Side of the Moon and Far Side of the Moon, Understanding Moon Motions 1-2 lab pages.

b. Have a large lunar map and models available for student use.

c. Have data pages for moon motions lab 1-2 available.

d. Have moon problem puzzle available.

TIME

a. Student section includes worksheet 8.

b. Have standard time zone map available (Milliken).

EARTH SPACE LOCATIONS

a. Need Atlases

b. Have data page available for circumpolar locations.

c. Set up a chart in the room. Label 0-23 hours right ascensions. Also begin in center and label 90° declination each line equals 2° less in declinations.

References:

Oxenhorn, Pathways Book 3

Namowitz and Stone, Earth Science, The World We Live In

Milliken transparencies

## HOW TO CONTRACT A SPECTROSCOPE

Materials: Old shoe box, two (2) sheets of straight edged paper, diffraction grating (13, 400 lines/ in 2)

Step 1. At one end of the box, cut a one half inch square hole about ½ inch from the left edge and one half inch from the bottom of the box.

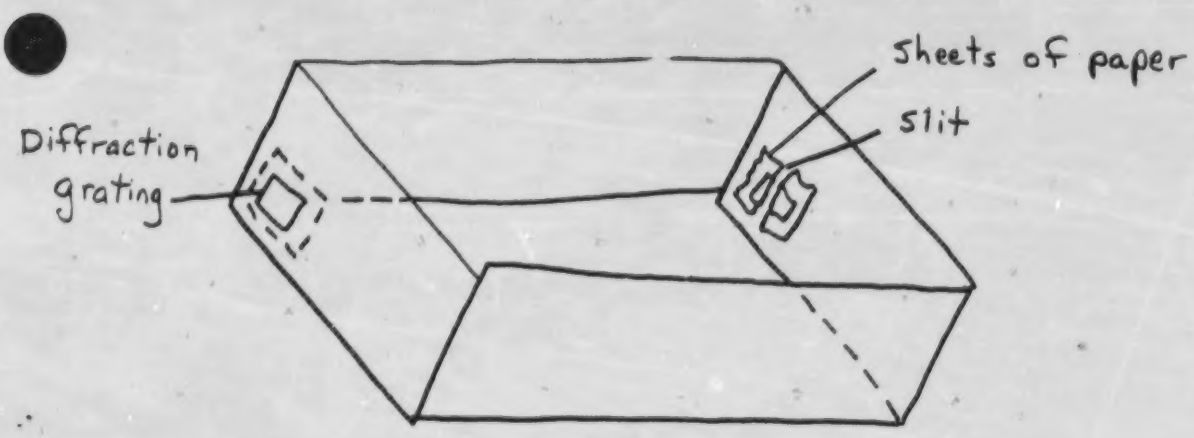
Step 2. Tape a piece of plastic diffraction grating on the inside of the box over this hole.

Note: Be sure the lines on the diffraction grating are vertical (up and down).

Step 3. At the other end of the box, cut a one half inch square hole about ½ inch from the SAME side of the box as the first hole. This hole should also be about one inch from the bottom of the box.

Step 4. Tape two (2) pieces of paper over this second hole in such a way that the edges of the paper form a very narrow vertical slit. (The opening should be just wide enough for light to pass through.)

Step 5. Consult the drawing below.



SAMPLE QUIZ

TELESCOPES

The study of stars and space is called ___(1)___. ___(2)___ are people who study stars and space for either a hobby or for a living. Astronomers are well paid.

Stars are studied with an instrument called ___(3)___ which is the chief instrument used in astronomy. The telescope was invented by ___(4)___. The two main optical telescopes are ___(5)___ and ___(6)___. The ___(7)___ telescope uses a lens to gather and focus light and the largest one is ___(8)___ in diameter and is called ___(9)___. The ___(10)___ telescope uses a mirror to magnify light and the largest one is ___(11)___ and is called the ___(12)___.

The ___(13)___ telescope was constructed like a huge saucer to receive radio signals from space. The largest one is ___(14)___ feet in diameter and is located in ___(15)___. The schmidt telescope takes ___(16)___ of the stars and the sky. The fifth type of telescope is the main instrument used to study the sun and it is called ___(17)___.

The first ancient observatory was called ___(18)___. This was a circle of columns and rocks arranged in an order to determine months, years, and seasons of the years. It also was used to predict eclipses. Today we can go to a ___(19)___ or ___(20)___ to study the stars and astronomy.

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SAMPLE QUIZ

SPECTROSCOPES

In addition to the telescope, the second most important instrument in astronomy is the __(1)__. This instrument is used to study the stars because it determines a stars __(2)__, __(3)__, and __(4)__.

The spectroscope works on the principle that as light passes through it, the lightwaves are __(5)__ or refracted and because the long waves are __(6)__ less than short waves the different colors are separated or __(7)__. Each __(8)__ has a different wave length. __(9)__ has the shortest wave length while __(10)__ has the longest wave length. The wide band or line of colors formed when the light is separated by a prism or diffraction grating is called __(11)__. The seven (7) colors in this line are __(12)__. An easy way to remember them is remember the name __(13)__.

There are three (3) kinds of spectra. Name them. __(14)__, __(15)__ and __(16)__. Highly heated gases give off a __(17)__ spectra. When a glowing solid passes through cooler gases a __(18)__ spectrum is formed. A __(19)__ spectrum results from compressed gases burning in or on a star. Another name for this is __(20)__.

Sometimes there are shifts in the dark lines. They usually indicate that a star is __(21)__. A shift toward the blue end means that a star is __(22)__ and a shift toward the red end means that a star is __(23)__. The first man to explain these shifts and measure them and illustrate them with sound was __(24)__.

A natural occurring spectrum is the __(25)__.

SAMPLE QUIZ

POINTS OF LIGHT

(1) are pin-point or small sources of light which we see at night. They vary or are different in several ways, list 3; (2), (3), and (4). Because of a difference in temperature, we can tell that stars have different (5), also we could see this if the atmospheric conditions are good. On a clear night we could see about (6) (generally how many) stars. In the day time we can only see one star which is (7). The stars we see at night are actually (8) just like our sun. Stars have different brightness and we call this (9) in astronomy.

If a star looked blue the temperature would be (10), but if it were red, the temperature would be (11). A rule to remember is, the (12) a star the bluer its color and the (13) it is the cooler it is. Our sun is an (14) colored star. Some stars are hugh in size and are called (15) while other stars are very small and are called (16). Our sun is (17) in size compared to other stars. We know from the bright and dark line spectra that most stars are made up of high concentrations of (18) and (19). Also spectra study shows us that stars are moving. Stars move one of two ways; either (20) or (21) from earth. This is difficult to detect or notice with our eyes because the stars are so very distant from earth. In fact new units of measurements called (22) were made and actually measure how fast light travels in one year. A shorter unit is the (23) which equals 93 million miles. When stars are in pairs and they are called (24). Stars die suddenly and with a hugh explosion, this is called (25).

The End.

SAMPLE QUIZ

GALAXIES

(1) are huge systems of millions of stars. We believe that our star - the sun - is only one among millions in the system called (2). We (3) can or can not see most galaxies because of the great distances between them and our sun. The nearest galaxy to earth is the great spiral of (4). Our galaxy and this one are alike in shape and it is by means of shape that galaxies are grouped. The three kinds of galaxies are (5), (6), and (7). Most galaxies resemble ours and therefore, most galaxies are (8) in shape.

Vast masses of stars and dust swirling about a central core of stars is called (9). Some galaxies have no particular or recognizable shape and are called (10). There are other deep space objects which appear to consist of dust or clouds of dust and these are called (11). Other objects such as (12) give off no light and are made visible by the surrounding light from other stars. And another kind of deep space objects about which little is known only transmits radio signals and is called (13).

Horsehead and Crab are names which refer to (14) while Andromeda refers to a famous (15).

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Galaxy Study

Name _____

pp.335-337 (Namowitz and Stone)

1. What is a galaxy? _____

2. You could think of galaxies as (see Herschel's idea) _____

_____

3. In what galaxy is earth located? _____

4. The three types of galaxies and description of each.

A. _____ = _____

B. _____ = _____

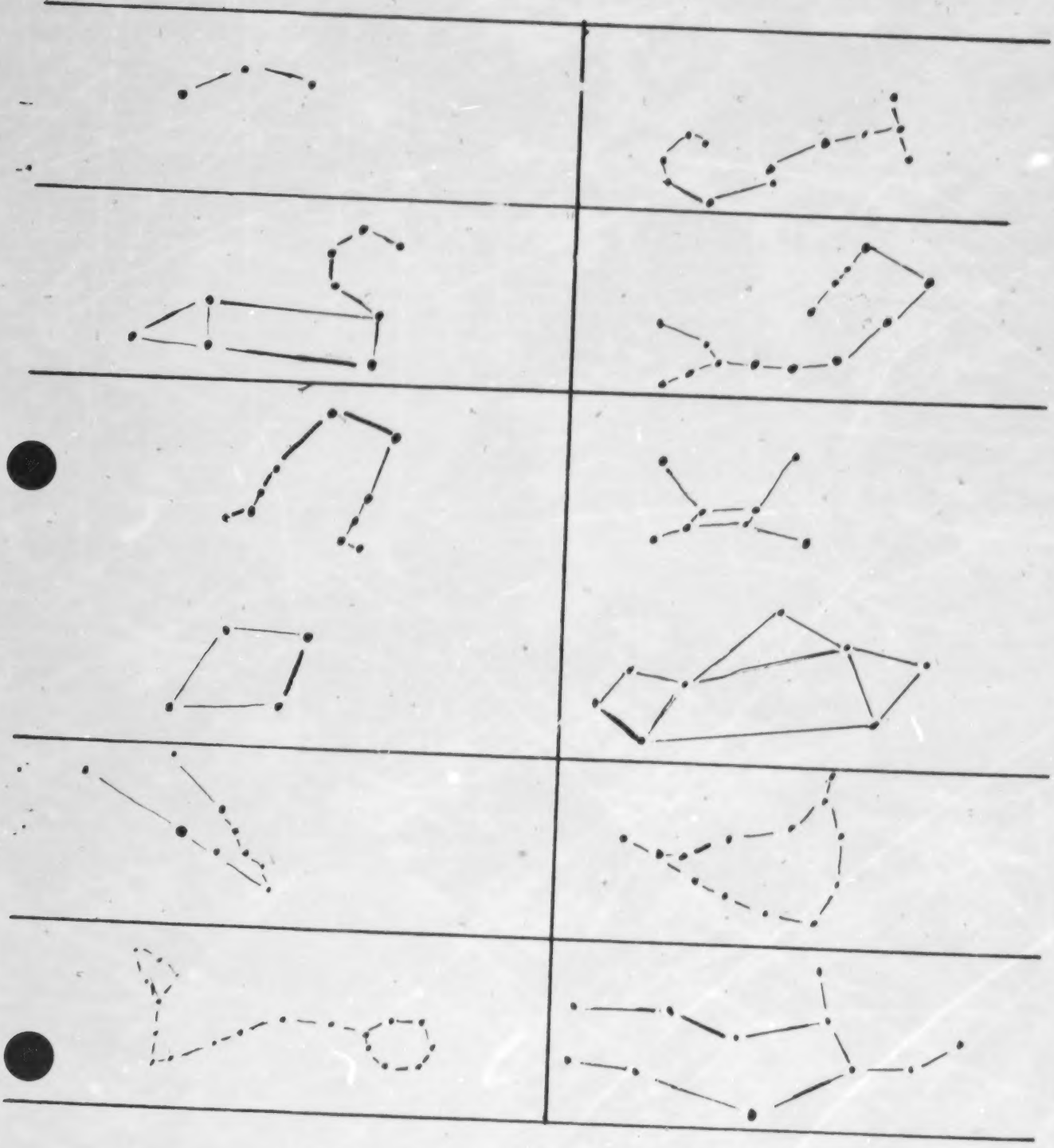
C. _____ = _____

5. Make a sketch of our galaxy. (p.336) Locate earth.

6. Drawings of the three types of galaxies: (slides)

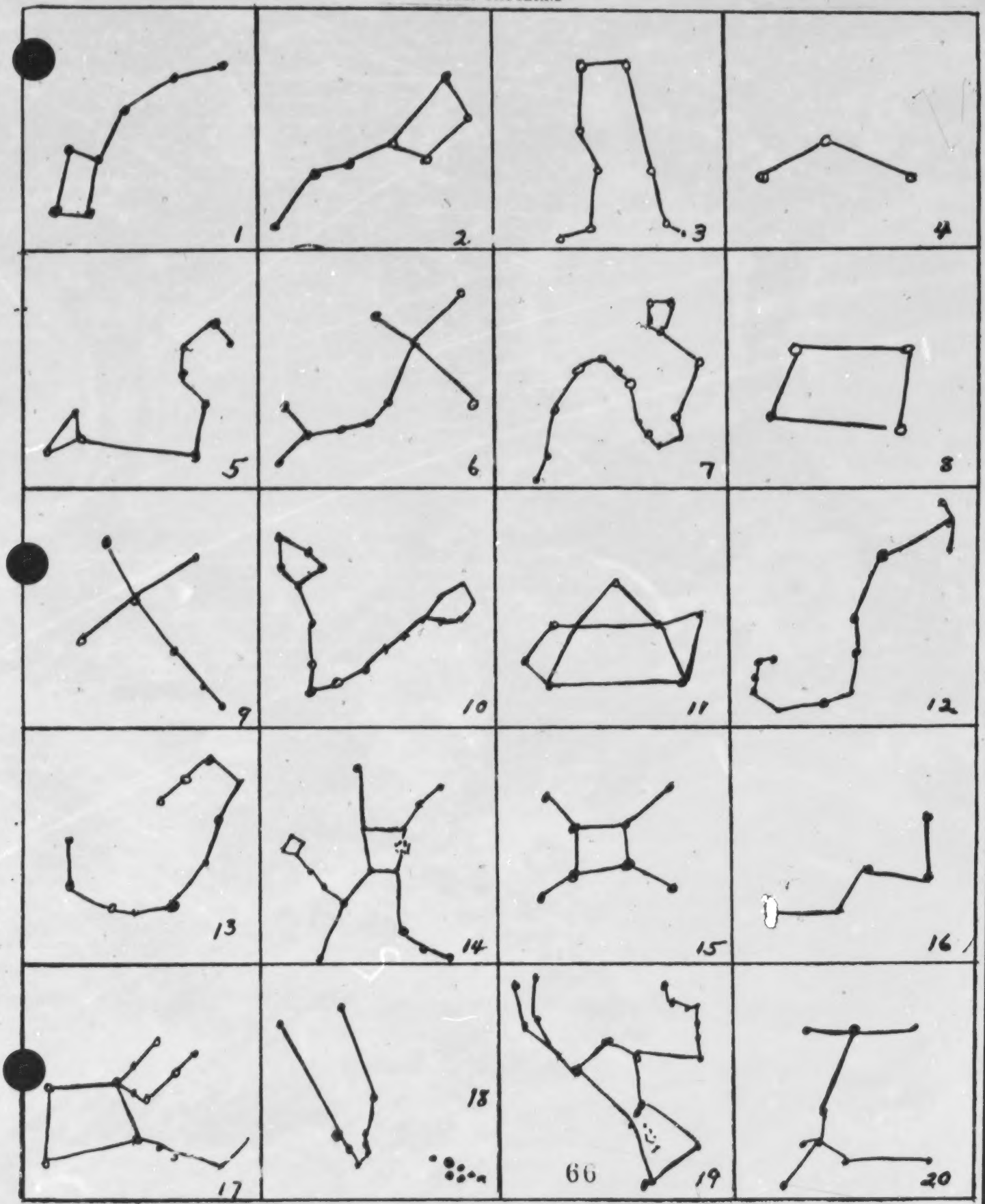
A. B. C.

# ZODIAC CONSTELLATIONS



SAMPLE QUIZ

STAR PATTERNS



SAMPLE QUIZ

STAR PATTERNS

A group of stars which make up an imaginary pattern or shape is called a ___(1)___. Most of these patterns have at least ___(2)___ (a no.) bright stars. These stars and most constellations were named by the early Greeks and Egyptians and other early peop1 Some stars are used for navigation such as the ___(3)___ in the Big Dipper which points directly to ___(4)___ which is the last star in the handle of the Little Dipper.

Some constellations we can see every night. These are called ___(5)___ because they circle around the North Star. Some constellations are named after famous people such as ___(6)___ and ___(7)___. Many constellations are named after ___(8)___. Eleven of the ___(9)___ zodiac constellations are named after this also. The reason that Capricorn is the constellation for the month of ___(10)___ is that it is when the sun can be found in that constellation. A good time to see Capricorn is ___(11)___. Another name for Capricorn is ___(12)___. Orion is called ___(13)___ and his big dog is called ___(14)___. ___(15)___ is another name for a star map.

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Nebula Study

Name_____

pp. 335-337-338

1. What is a nebula?

2. The plural of a nebula is?

3. The main gas in these clouds is

4. List the names of some famous nebulae.

A.
B.
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J.

5. Roughly sketch two nebulae:

# DATA PAGE FOR H-R DIAGRAM

## The 20 Brightest Stars

| Star | Temperature | Luminosity |
|---|---|---|
| Sirius | 10,400 | $2 \times 10^{1}$ |
| Canopus | 7,400 | $1.2 \times 10^{3}$ |
| Alpha Centauri | 5,800 | 1 |
| Arcturus | 4,500 | $9 \times 10^{1}$ |
| Vega | 10,700 | $4 \times 10^{1}$ |
| Capella | 5,900 | $1.3 \times 10^{2}$ |
| Rigel | 11,800 | $4 \times 10^{4}$ |
| Procyon | 6,500 | 6 |
| Betelgeuse | 3,200 | $1.1 \times 10^{4}$ |
| Achernar | 14,000 | $1.7 \times 10^{2}$ |
| Beta Centauri | 21,000 | $3.3 \times 10^{3}$ |
| Altair | 8,000 | 10 |
| Alpha Crucis | 21,000 | $2.7 \times 10^{3}$ |
| Alderbaran | 4,200 | $8 \times 10^{1}$ |
| Spica | 21,000 | $1.9 \times 10^{3}$ |
| Antares | 3,400 | $4.4 \times 10^{3}$ |
| Polluk | 4,900 | $3.3 \times 10^{3}$ |
| Formalhaut | 9,500 | $1.1 \times 10^{1}$ |
| Deneb | 9,900 | $4 \times 10^{4}$ |
| Beta Crucis | 22,000 | $4.8 \times 10^{3}$ |
| Sun | 5,600 | 1 |

## The 20 Nearest Stars

| Star | Temperature | Luminosity |
|---|---|---|
| Alpha Centauri (A) | 5,800 | 1 |
| Alpha Centauri (B) | 4,200 | $3.3 \times 10^{1}$ |
| Alpha Centauri (C) | 2,800 | $1 \times 10^{-4}$ |
| Barnards Star | 2,800 | $4 \times 10^{-4}$ |
| Wolf 359 | 2,700 | $1.3 \times 10^{-4}$ |
| Lalande 21185 | 3,200 | 4 x 10-2 |
| Sirius A | 10,400 | $2.5 \times 10^{-1}$ |
| Sirius B | 10,700 | $1.7 \times 10^{-3}$ |
| Luyten 726-8A | 2,700 | $5 \times 10^{-3}$ |
| Luyten 726-8B | 2,700 | $3.3 \times 10^{-5}$ |
| Ross 154 | 2,800 | $4 \times 10^{-4}$ |
| Ross 248 | 2,700 | $1 \times 10^{-4}$ |
| Epsilon Eridani | 4,500 | $2.5 \times 10^{-5}$ |
| Ross 128 | 2,800 | $2.5 \times 10^{-4}$ |
| Luyten 789-6 | 2,700 | $7.7 \times 10^{-5}$ |
| 61 cygni A | 4,200 | $6.7 \times 10^{-2}$ |
| 61 cygni B | 3,900 | $3.3 \times 10^{-2}$ |
| Procyon A | 6,500 | $1.7 \times 10^{-1}$ |
| Procyon B | 7,400 | $4 \times 10^{-4}$ |
| Epsilon Indi | 4,200 | $1 \times 10^{-1}$ |
| Sun | 5,600 | 1 |

SOLAR SYSTEM - SUN

Measuring the Sun's Diameter

Materials:

projection materials from ESCP kit (pinhole card, slide tray, circle card)
meter stick or ruler
pencil, paper

Procedures:

1. Draw a small circle (with pencil) on the smooth 'circle' card. Measure the size or diameter -this will be the value for s.
2. Stand with back to sun (never look directly at the sun).
3. Carefully move the cards until the sun's image just fills the circle.
4. Now measure the distance between cards very accurately! This will be the value for d.
5. Using the formula $\frac{s}{d} = \frac{S}{D}$ where d is distance between the 2 cards; s is size of small circle or sun's image; S is size of sun; D is distance between earth and sun or 93 million miles. Solve for S.

Hints:

63,360 inches in 1 mile

s = should be a fraction of one inch

SHOW ALL MATH WORK

SAMPLE QUIZ

SOLAR SYSTEM - SUN

The sun is the nearest star to earth and therefore it is the __(1)__ star as seen from earth. The sun can be called __(2)__ when it is compared to the nearer and brighter stars. Our sun is many times larger than earth in diameter, surface area and volume, but it is only __(3)__ as dense (weight) as earth. The reason for this is because the earth is solid (mostly) while the sun is __(4)__.

Due to many unique problems, special instruments were developed to study the sun and learn information about it. The __(5)__ telescope was designed to photograph the sun and make three foot projections of the sun. Another instrument, the __(6)__ makes it possible to identify a single element on the sun. The __(7)__ allows us to study the sun's corona. We know the sun is made up of __(8)__ layers. The center part which we call __(9)__ is probably millions of degrees hot. Surrounding this region is the __(10)__ which is the visible part of the sun. In this area sunspots occur. Sunspots are __(11)__ in appearance and may be caused by storms which would make this area __(12)__ in temperature. By observing sunspots we now know that the sun __(13)__ (what motion). The name for the sun's atmosphere is __(14)__. We see this layer only during an eclipse which is when we see hugh flame-like clouds of gases erupting from the sun, these are called __(15)__ and may be accompanied by __(16)__ (refer to Current Science). How do these explosions affect the earth? __(17)__ and __(18)__.

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The sun gets its energy by a chemical reaction in which hydrogen is converted into (19). This process called (20) was explained by Einstein.

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SAMPLE QUIZ

SOLAR SYSTEM - PLANETS

The solar system is the name given to the sun and the nine (1). The planets (2) around the sun due to the gravitational attraction of the large mass on the smaller masses. This motion takes about 88 days for (3) and 247 years for (4). The shape of this orbit was thought to be (5), but we now know it is oval shaped or (6). While the planets are going around the sun, they are also spinning on an imaginery axis like a top, this is called (7) and causes the planets to have night and day.

The planets vary in size, surface temperature, distance from the sun, (8) and (9). Smallest of the planets is (10) while the giant is (11). The hottest one is (12) and the coldest is also the (13). Going around the planets are from (14) to (15) natural satellites. All but one of these planets have (16), however, three of them contain water.

Other than a major star and planets, there are comets and meteors found in a (17). Also there is an area of small rock fragments which lies between Mars and Jupiter and according to Bode these rock pieces may have been a (18). In making his point, Bode invented a new term called - (19) which he defined as the standard distance between the earth and the sun. This distance equals (20).

Some scientists group the planets into two categories; the outer planets, or those beyond the asteroid belt and the (21) planets, or those which lie between the sun and asteroids. The planets which make up this last group are (22), (23), (24), and (25).

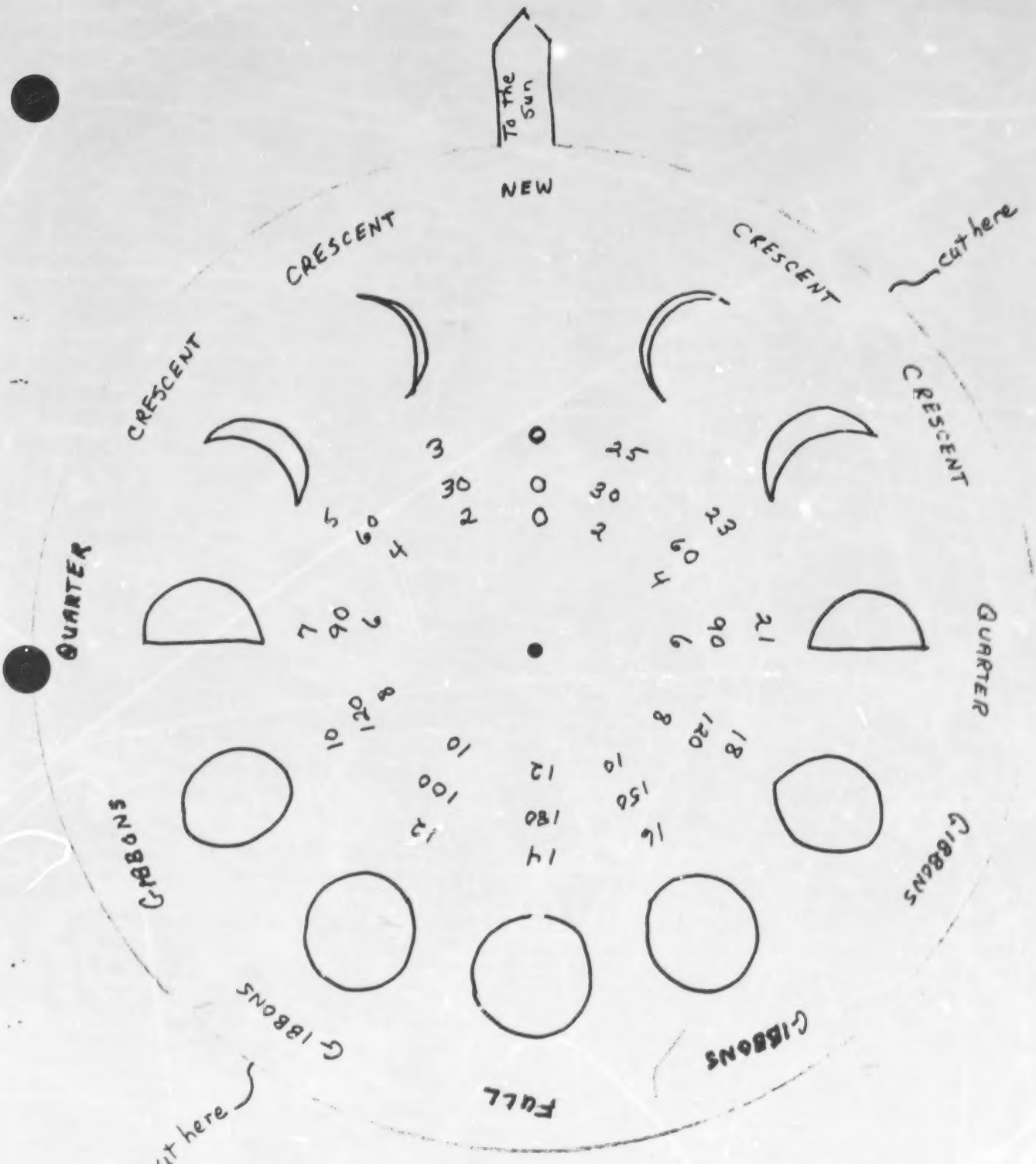
SAMPLE QUIZ

Supply the answers. (40 points)

1. Name the planets which are larger than earth. (4)
2. Name the planets which are closer to the sun than earth. (2)
3. Name the planets which have no moons. (3)
4. Name the planets which have days shorter than earth's. (4)
5. Name the planets which have years longer than earth's. (6)
6. Name the planet which has "days" longer than a "year". (1)
7. Name the planet with water. (3)
8. Name the planets from the sun outward. (9)
9. Where could a missing planet occur? Support your answer. (8)

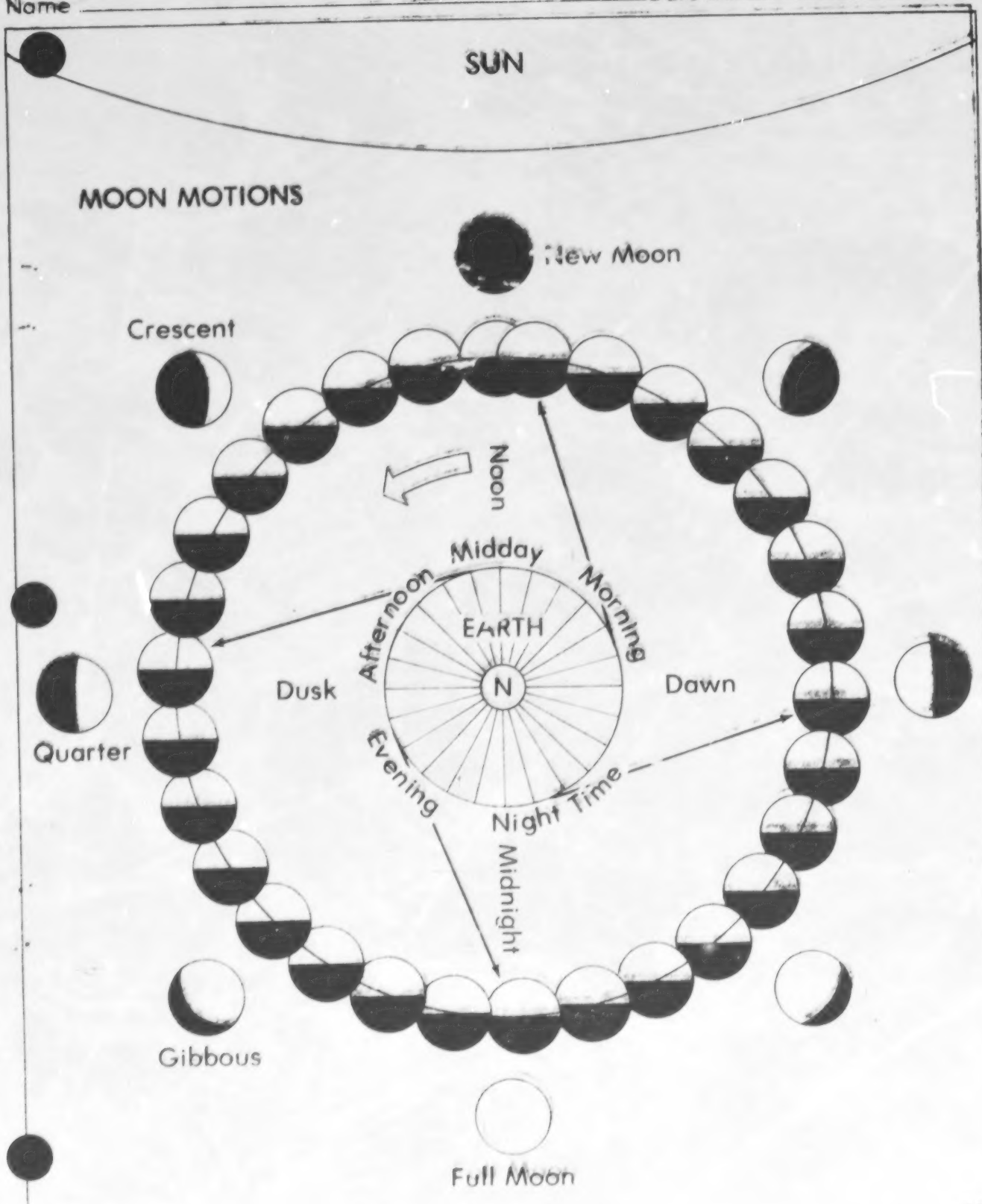
Matching (10 points)

| | |
|---|---|
| _____1. Mercury | A. 57° F |
| _____2. Venus | B. 12 moons |
| _____3. Earth | C. 247 days rotation |
| _____4. Mars | D. Rings |
| _____5. Jupiter | E. 3675 million miles |
| _____6. Saturn | F. + 800° F |
| _____7. Uranus | G. 30,000 miles |
| _____8. Neptune | H. 28,000 miles |
| _____9. Pluto | I. 24 hr. 37 min. |
| _____10. one of the above | J. 3,020 miles |




Horizon: may be cut out and added to line up with your horizon.

Name _____ Date _____

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Moon Problem

You are a member of a space crew which was scheduled to rendevous with a mother-ship on the lighted surface of the moon. Due to mechanical difficulties, your ship was forced to land at a spot about 50 miles from the rendezvous point. During re-entry and landing much of the equipment aboard was damaged. Since survival depends on reaching the mother-ship, the most critical items available must be chosen for the 50 mile trip. Below are listed the 15 items left undamaged after landing. Rank these items in terms of their importance for your crew in helping them to reach the rendezvous point. Place the number 1 by the most important item, the number 2 by the second most important, and so on through number 15, the least important. Explain how each item is useful or not useful.

_____ matches _____

_____ food concentrate _____

_____ 50 feet of rope _____

_____ parachute (silk) _____

_____ heating unit _____

_____ 45 calibre pistols _____

_____ dehydrated milk _____

_____ tank of oxygen _____

_____ stellar map (of moon's constellation) _____

_____ life raft (with $CO_2$ bottles) _____

_____ magnetic compass _____

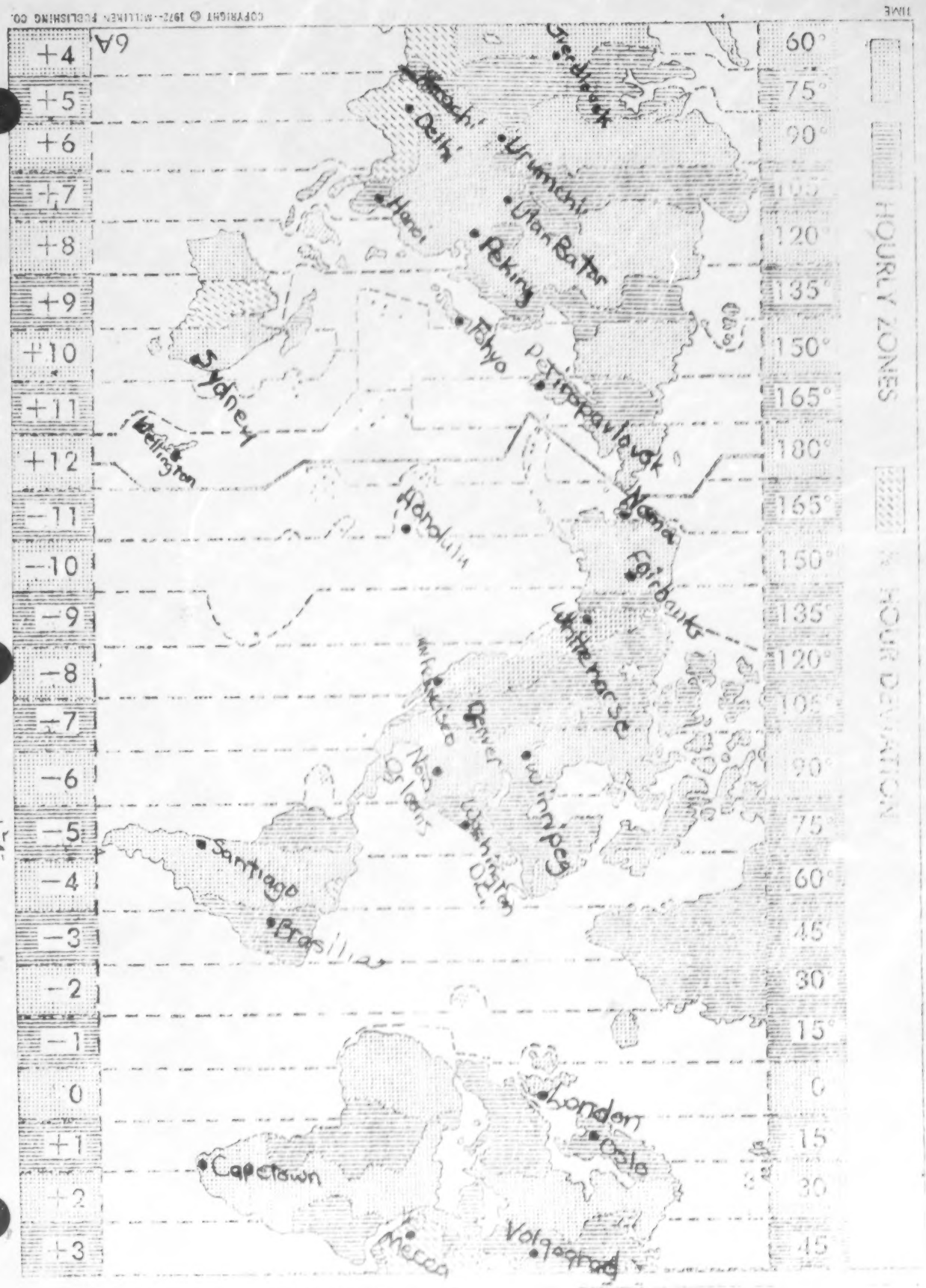
_____ water _____

_____ signal flares _____

_____ first aid kit containing injection needles _____

_____ solar powered FM receiver transmitter _____

BEST COPY AVAILABLE


STANDARD TIME ZONES
HOURLY ZONES
½ HOUR DEVIATION
+4
+5
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+9
+10
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+12
−11
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Nome
Fairbanks
Whitehorse
Edmonton
Winnipeg
Denver
Minneapolis
New Orleans
Santiago
Brasilia
Capetown
London
Oslo
Mecca
Volgograd
Tokyo
Peking
Ulan Bator
Urumchi
Delhi
Karachi
Petropavlovsk

# LOCATION DATA FOR CIRCUMPOLAR STARS AND CONSTELLATIONS

| STAR | 1 hr min Dec | 2 hr min Dec | 3 hr min Dec | 4 hr min Dec | 5 hr min Dec |
|---|---|---|---|---|---|
| A | 11- 0 - 62° | 14 - 50 - 74° | 23 - 0 - 80° | 5 - 20 - 74° | 10 - 0 - 76° |
| B | 11- 0 - 56° | 15 - 20 - 72° | 23 - 40 - 68° | 4 - 40 - 66° | 12 - 0 - 73° |
| C | 11-40 - 54° | 16 - 20 - 75° | 21 - 0 - 70° | 3 - 20 - 68° | 13 - 0 - 70° |
| D | 12- 20- 57° | 15 - 40 - 77° | 23 - 0 - 58° | 3 - 20 - 58° | 13 - 30 - 64° |
| E | 12- 50- 56° | 16 - 40 - 82° | 21 - 20 - 62° | 2 - 0 - 62° | 14 - 0 - 56° |
| F | 13- 20 - 55° | 17 - 0 - 88° | | | 14 - 40 - 60° |
| G | 13- 20 - 55° | 0 - 0 - 90° | | | 15 - 40 - 65° |
| H | | | | | 17 - 0 - 72° |
| I | | | | | 16 - 20 - 64° |
| J | | | | | 16 - 0 - 54° |
| K | | | | | 16 - 10 - 51° |
| L | | | | | 15 - 40 - 52° |
| M | | | | | 15 - 40 - 54° |

80

## ASTRONOMY CHECKLIST AND GRADES (SAMPLE)

| | Student's Name | John Doe |
|---|---|---|
| Instruments | Extra Credit | |
| | Quiz | |
| | Worksheet 2 | |
| | Spectrum lab page | |
| | Spectroscope Construction | |
| | Worksheet 1 | |
| | Focusing Refr. and Refl. | ✓ |
| | Drawing of Light in Telescope | ✓ |
| | | A |
| Points of Light. Star Patterns | Extra Credit | |
| | Quiz | |
| | Galaxy Card Lab | |
| | Worksheet 4 | |
| | Drawing of Galaxies | |
| | Worksheet 3 | |
| | Star Window lab page | ✓ |
| | | B |
| Sun | Extra Credit | |
| | Quiz | |
| | Analemma Dilemma | |
| | Sundial Paragr. | |
| | Sundial Construction | |
| | Worksheet 6 | |
| | H-R Diagram | |
| | | A |
| | | B |
| | | A |
| | | A |

Grading System

A C E
B D I = Inc.
✓ = Comp.

| | |
|---|---|
| Earth & Space Locations | Extra Credit<br>Quiz<br>Circumpolar Lab<br>Coordinate Det. Exerc.<br>Place Locations<br>Worksheet 9 |
| Time | Extra Credit<br>Quiz<br>Greenwich & Intern'l Dateline<br>Time Zone Problems<br>Worksheet 8 |
| Moon | Extra Credit<br>Quiz<br>Moon Motions II<br>Moon Motions I<br>Far Side of the Moon<br>Near Side of the Moon<br>Worksheet 7<br>Comparison Page |
| Planets | Extra Credit<br>Quiz<br>Relative Distance Diag.<br>Plant X<br>Shape of Planets Orbit<br>Top View Diagram<br>"How Well..." Page<br>Planet Inform. Chart |

## Evaluation Form for Teachers

1. Name of the mini course _____

2. Was this unit appropriate to the level of your students?

3. Explain how this mini course was used with your students. (Individual, small group, or total class)

4. Identify the plus factors for this course.

5. List the changes that you would recommend for improvement.

7. Did you use any other valuable resources in teaching this unit? If so, please list.

PLEASE RETURN TO SCIENCE SUPERVISOR'S OFFICE AS SOON AS YOU COMPLETE THE COURSE.

# ADDITIONAL SCIENCE MINI-COURSES

## LIFE SCIENCE

| | Prepared by |
|---|---|
| A Study for the Birds | Terrence Best |
| Creepy Critters (Snakes) | Terrence Best |
| How's Your Plumbing? | Paul Cook |
| Guess Who's Been Here for Dinner | Paul Cook |
| Plants - The "Other" Living Things | Sharon Sheffield |
| Let's Look at You - The Human Organism | Sharon Sheffield |
| Classification: Why is There a Need? | Melvin Whitfield |
| Protist: The "Unseen" Kingdom | Melvin Whitfield |

## EARTH SCIENCE

| | |
|---|---|
| Coastline Development | Nelson Ford |
| Ocean Currents | John Fradiska |
| Features of the Ocean Floor (Ocean Floor Topography) | John Fradiska |
| Space and Its Problems | John Geist |
| Invertebrate Fossils: Clues to the Distant Past | John Geist |
| An Attempt towards Independent Study in Astronomy | John Geist |

## PHYSICAL SCIENCE

| | |
|---|---|
| Household Chemistry | Ross Foltz |
| Notions on Motions | Kenneth Howard |
| Environmental Chemistry | Fred Meyers |